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An Interesting Letter from Mr. Ferranti, of London, Replying to Dr. Van der Weyde.

TO THE EDITOR OF ELECTRICAL REVIEW:

My attention has just been drawn to the article contained in your issue of the 8th ultimo, written apparently by Mr. P. H. Van der Weyde, in which this gentleman states that the most recent German improvements in dynamo construction have chiefly been in an enormous increase in the size of revolving armature to such a degree even as to make it large enough to perform a double function namely, that of the flywheel of the driving engine also, and he refers to the alternating current of Girard in France of 250 horse-power and the Gordon generator, and he also refers to the machine of Gans & Company of Buda Pesth, of 140 horse-power. He then states that all this appears to have stirred up the capitalists of London who are preparing a colossal central station to light up the city.

Mr. Van der Weyde has evidently not kept himself *au courant* with the events of the day as he could not, if he had done so, have suggested that London capitalists had been stirred up to attempt their present undertaking, by what had been done by the others to whom he refers. This will be clear to your readers when I point out, that in the first place the largest dynamo made by the German company namely, the Helios company near Cologne, may be large according to Mr. Van der Weyde's ideas but it only gives 110 horse-power. Now this is a smaller machine than I make, my smallest machine being of 150 horse-power capable of lighting 3,000 ten candle-power lamps, and it is foolish to talk of my having copied the example of the Helios machine which has only just comè out, when I have had two machines running for three years each giving 800 electrical horse-power or lighting 16,000 ten candle-power lamps and which machines, as you will observe, are about or rather more than seven times as large as the "big" dynamo to which Mr. Van der Weyde refers.

Secondly, Mr. Van der Weyde speaks of Girard's alternating current dynamo; now this I have never heard of except on paper and as far as I know it has never got beyond the design. Even if it has been constructed it cannot be compared in size to the two machines I have already referred to and which have now been running as before stated for some years.

Then Mr. Van der Weyde speaks of the Gordon generator which he says is of still larger construction and also of that made by Gans & Company. Neither machines approach 800 horse-power and it is therefore unjust to say that stirred up by the example of the machines to which Mr. Van der Weyde refers, London capitalists have gone in for building large machines, and further I may point out that London capitalists have nothing to do with the matter as the machines are being manufactured by me and put upon the market. Mr. Van der Weyde then also goes a good deal beyond the mark when he speaks of a 10,000 horse-power dynamo which I am now building and which he says will give 600,000 incandescent lights; as Mr. Van der Weyde should be aware 10,000 horse-power will not give more than 200,000 lights of ten candle-power each. A series however of these large machines are now being made which will together light from 1,000,000 to 2,000,000 lamps.

Mr. Van der Weyde then goes on to say that this machine will be of the kind suggested by Sir Wm. Thomson and Alfred Thomson, and as constructed by Ferranti.

Here, again, before this gentleman attempted to instruct the public, he should ascertain the facts, as Sir Wm. Thomson was the original patentee of a zigzag armature, an armature which is about the same date I patented jointly with Mr. Alfred Thomson, the two sets of patents ultimately being by agreement worked together. So far as Mr. Alfred Thomson is concerned, his name was inserted merely as a trustee for me, as I was at the date of the patent under age, and Mr. Alfred Thomson is the last man to attempt to pose as the inventor of the machine referred to, or as a scientific expert. And he had as much to do with the invention as you had.

Mr. Van der Weyde then goes on to speak of this first zigzag machine, as shown in the Aquarium, being very unsatisfactory, stating that it developed great heat, and was more wasteful than any other machine there. This statement is untrue. The machine shown at the Aquarium in 1883, was perhaps a high speed machine as we consider things at present, but it was out and away the most economical and mechanically perfect machine that had ever been thought of up to that date. There are a large number of this type of machine now running in this country; they have given universal satisfaction, and though have been running for years, they have not cost one shilling for repairs. But Mr. Van der Weyde's inaccuracies do not stop here; the machines that are being made of 10,000 horse-power are in no way like the original zigzag machines. They have not zigzag armatures, they are a completely new invention, and are vastly superior to the old machine.

In justice to myself, I am bound to call your attention to the various points referred to in this letter, and I answer that it will afford Mr. Van der Weyde great pleasure to find that his inaccuracies have been pointed out and corrected.

Yours respectfully,

S. Z. DE FERRANTI.

London, England, Jan. 5, 1889.

FIG. 2.—THE PRESS USED IN THE HOLLERITH TABULATING SYSTEM.

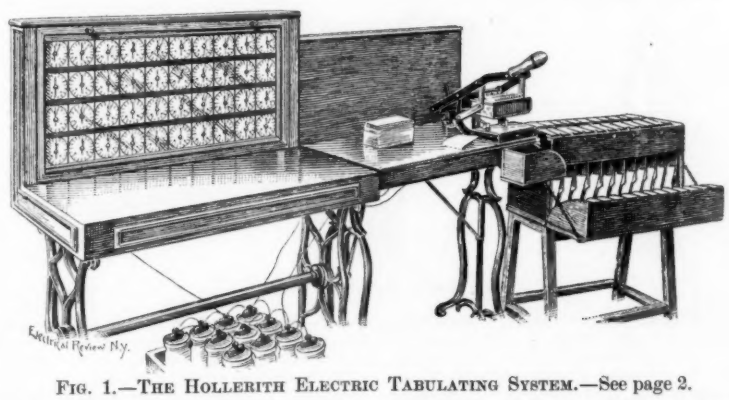

FIG. 1.—THE HOLLERITH ELECTRIC TABULATING SYSTEM.—See page 2.

Electrical Exhibitors at the Paris Exposition.

The following comprises the names of companies and individuals who have applied for exhibition space at the Paris International Exposition:

Crocker & Wheeler, New York, electric motors. Charles Colné, electrical batteries. Carl Hering, Philadelphia, electrical appliances. Charles Dion, electrical appliances. Heisler Electric Company, of St. Louis, electric lighting apparatus. American Graphophone Company, New York. American Bell Telephone Company, Boston. J. Harris Rogers, visual synchronism. F. Benedict Herzog, electrical signaling apparatus. Lieut. F. J. Patten, telegraph and other electrical appliances and metres. Connolly Bros., Washington, telegraphic apparatus. Cobb Vulcanite Wire Company, Wilmington, Del. James N. Chisholm, Prof. Gray's telautograph. Munson lightning conductor, Indianapolis, Ind. Elmer A. Sperry, Edison Electric Light Company, electric lighting apparatus. Thomson Electric Welding Company, Boston, Mass.

The "Faraday" in Demand.

The Mexican Telegraph Company, with headquarters at the City of Mexico, has arranged for a new cable across the Gulf. The Texas end of the company's lines was removed from Brownsville to Galveston some years ago. Its connections are through the South American Telegraph Company which has wires across the Isthmus of Tehuantepec, and business has so increased as to require additional facilities—hence the new cable which will be completed to Galveston about the 10th of next month. The laying will be commenced the present month, at Coatzacoalcos, 200 miles south of Vera Cruz. From that point to Galveston is about 1,000 miles—the length of the cable, which weighs about three tons to the mile, and the "Faraday" is to do the work. The vessel left Liverpool December 28, for her new field. The "Faraday" laid the two French Atlantic cables, the two Gould cables, and the cable for the N. S. Cable Company.

THE ELECTRIC CLUB.

An Able and Highly Interesting Address by Mr. E. N. Dickerson, of New York.

THE FIRST CLUB MEETING OF THE NEW YEAR LARGELY ATTENDED—THE ADDRESS AND THE DISCUSSION.

If all the monthly meetings of the Electric Club during the year 1889 are as largely attended and as greatly enjoyed as the January meeting, the members of the Club will indeed have reason to be proud of their young organization. The first meeting of the New Year was held Thursday evening, January 17th, and an attendance that filled the large double parlors and overflowed into the adjoining rooms greeted the speaker of the evening, Mr. E. N. Dickerson, the eminent patent lawyer of this city. A number of out-of-town members were present, among them S. A. Duncan, E. G. Acheson, of Pittsburgh; Geo. F. Porter, Philadelphia; C. J. H. Woodbury, Col. C. M. Ransom, R. F. Ross, Boston; W. A. Kriedler, Chicago; Chas. E. Chapin, Hartford; H. D. Stanley, Bridgeport, and Capt. A. E. Prorkowski, Imperial German Army. Among the New York members were Capt. Henry Erben, U. S. N., Lieut. F. W. Toppan, U. S. N., Lieut. Ross, U. S. N., H. L. Storke, O. E. Madden, Chas. W. Gould, Henry A. Reed, John A. Seeley, Chas. W. Spear, H. L. Lufkin, S. S. Wheeler, John C. Tomlinson, Geo. B. Coggeshall, Henry Hine, Geo. T. Manson, Geo. Worthington, Cyrus O. Baker, Jr., Dr. Otto A. Moses, E. T. Gilliland, Geo. M. Phelps, C. H. Barney, Walter C. Kerr, W. D. Dickey, W. H. Baker, A. V. Garratt, H. C. Adams, J. P. McQuaide, S. M. Young, W. L. Candee, E. N. Dickerson, E. N. Dickerson, Jr., W. H. Fleming, T. Grimwood, E. M. Hamilton, F. J. Hovey, S. M. Hamill, Jr., W. H. Johnstone, Thos. L. Scovill, P. H. Alexander, B. B. Nostrand, Jr., A. F. Stanley.

The meeting was called to order at 8.30 o'clock, by Mr. E. T. Gilliland, first vice-president, and Mr. E. N. Dickerson was introduced. The speaker was in the happiest of moods, and was evidently speaking on a subject with which he was not only familiar, but one in which he took the most lively and enthusiastic interest. Applause greeted him on many occasions. In the discussion which followed, animated as it was at times, the best of good nature prevailed, and when the meeting adjourned it was with a unanimous vote of thanks to Mr. Dickerson for his admirable lecture, so pleasantly and graphically delivered.

The appetizing little supper, set out by the Club's management, which all present enjoyed after the meeting, was a particularly sociable and pleasant affair. Mr. Chas. W. Gould, of the Board of Managers, generously remembered that this was the first meeting of the new year, and as his good wine went around was compelled to respond to a toast which he did most happily.

We present the address and the discussion in full below:

The Steam Engine—Its Principles, its Development, its Future and Perfection.

Gentlemen of the Electric Club:

In the year 1830 our great countryman, Professor Joseph Henry, who was the pioneer discoverer in electro-magnetism in this country, after a series of brilliant investigations of the principles of electricity, pro-

duced the first electro-motor ever known to man, and prophesied that future discoveries would be made which would render the principle then exhibited available and valuable. At that time galvanic electricity was produced only by the combustion of zinc in galvanic batteries, and Professor Henry pointed out that so expensive a fuel as zinc could not compete commercially with coal for the generation of power, and that, therefore, the electro-motor must be limited in its uses to cases where some special convenience would compensate for the increased expense.

In 1831 Professor Henry in this country, and Faraday in England, almost simultaneously, but independently of each other, discovered that electricity could be produced in indefinite quantities by the combination of horse-power with a magnet; and electricity thus produced was called magneto-electricity. This, the greatest of all the discoveries in electricity, opened the door to an unlimited application of power for its production, and it was left to ingenious electricians to invent forms of apparatus by which in the most effective and ecomical way, the desired result could be accomplished.

The most important improvement, and which has practically superseded all others in the devices for developing the principles established by the discoveries of Professors Henry and Faraday, was made by Pacinotti, whose apparatus, modified subsequently by ingenious inventors, is now in universal use, producing practical results so near to the theoretical ones that more than 90 per cent. of the power expended upon the generating machine reappears in the form of electricity, leaving less than 10 per cent. to be saved (if it can be saved) by other improvements.

Founded thus upon the discoveries of the scientists, and practically applied to the arts by the inventors, a complete system for the creation and distribution of power through the intervention of electricity has sprung up, occupying the attention of thousands of skilled and scientific men, giving employment to hundreds of thousands of operators, and conferring upon humanity inestimable blessings. So far as we now know, this whole system depends upon the steam engine; and it must continue to depend upon that means for generating power until, in the future, the discovery shall be made of some means of converting the heat of combustion directly into electricity without the intervention of any other agency. When that is done—and it is entirely within the laws of nature—then the steam engine will disappear in connection with the generation of electricity; but until that is done, the steam engine is the important factor in the problem, and therefore is a subject of great interest to you, as electricians, both in a scientific point of view and in its practical application; and because of this connection you have honored me with your invitation to speak to you to-night on the subject of the steam engine, its past development, its present capacity, and its future limitations.

The subject is so large a one that within the compass of a single lecture it is impossible to do more than to give you an outline of its history, and the principles upon which it operates, and which limit its capacity.

The first steam engine of which we have any knowledge (although, indeed, if the records had not perished we should have known much more on the same subject), was made by Hero, of Alexandria, more than two thousand years ago. It was a perfectly practical operative machine, and has been in use within a very recent period for the purposes of driving saw mills. Its principle is that of tangental reaction—the steam escaping tangentally at the periphery of a revolving wheel. Shortly after Hero's date, the progress of science and art, which had been very great in Alexandria, was arrested by that flood of ignorance and superstition, which for ages chained down the intellect of man; and until Lord Bacon shed the light of his genius upon the world, philosophy and religion were united in despising the practical arts of life, by which the physical condition of humanity is improved, and, as a consequence, its intellectual capacity developed.

Under the new impulse the steam engine again appeared, but was used chiefly for the purpose of pumping water, until James Watt, about a century ago, took up the subject, and brought to bear upon it one of the greatest and most profound intellects which has ever been directed to the practical subordination of the laws of nature to the wants of man. The progress which he made was marvelous. He discovered all the laws which we now know with almost perfect precision, and he showed us how to apply them to produce results in almost perfect accordance with those laws under which steam must act.

Let us catalogue what this great genius did. He discovered the essential truth that steam must be condensed in a vessel other than the cylinder it is used to produce power, as had formerly been done; and he invented the application of the air pump to the condenser in order to make a true steam engine—that is, an engine from which the air is excluded and in which the piston works between two vessels, the boiler and condenser, each of which contains steam, but of different pressures, the power resulting from that difference.

He invented two forms of condensers—the "jet condenser," in which the steam is cooled by a spray of cold water injected into it, to be used when fresh water is available; and the "surface condenser," in which the steam is separated from the cold water by a thin partition of metal, and is condensed by contact with the cold surfaces. Without this last invention our modern steamships could not carry high steam in their boilers, and could not attain their wonderful speed.

He discovered the law under which steam used expansively increases its power in a certain ratio; and he invented the best form of cut-off for utilizing this discovery known to man, until it was improved upon the same principles by Mr. Sickles, of this city, in 1842.

He invented the "indicator," an instrument which gives us a graphic representation of the forces exerted by the steam, and proves the truth of the laws he discovered.

He invented the "single poppet-valve" for admitting and excluding steam from the engine, which is theoretically perfect, *and without which it is almost impossible* to make an engine give the full value of the steam used in it. There ought to be a statute in the interests of humanity, requiring all engines to use it when the rate of speed is not so high as to compel the use of the inferior slide valve: in the interest of humanity, I say; because it would save a vast amount of coal in the ground for future generations.

He invented the steam jacket to surround the cylinder with an envelope of hot steam, in order to preserve the heat of the steam within, while expansion is occurring and giving out power.

He invented the "fly-ball governor" for maintaining uniform speed of the engine under various conditions of load and pressure.

And he invented a great number of subordinate details, too numerous to mention here; and, as if to admonish the world not to depart from these principles, he invented the "copying press" now in common use everywhere.

When he died he seems to have left no successor capable of appreciating the discoveries he made; and for a generation after his death the art of producing power from fuel by the intervention of a steam engine retrograded, so that less power was obtained from a pound of coal consumed than could be obtained by the use of methods invented and fully explained by James Watt.

The problem of the steam engine is to convert the potentiality of combustion into dynamic energy; and that steam engine is the best which can obtain the most power from the least coal. In the eternal cycle which with God began, force in a protean form remains constant; and whether it is applied to the uses of man, or whether it is expended in some useless or injurious effect, depends upon how nearly imperfect man can obey the laws of nature in dealing with it. You, gentlemen, are dealing with one form of force which has eluded thus far all investigations into its substance; but it is but one section in the cycle, and is necessarily coupled to what precedes and what succeeds it under the immutable laws of the correlation of energy. You and your predecessors have dealt with this form of force as it has passed through your hands with wonderful success. The talent that has been given to you has not been wrapped in a napkin and buried in the ground. It may be truly said to you "Well done good and faithful servant;" for you have converted dynamic energy into electricity, and delivered it for conversion into light or some other form of force almost unimpaired. You have lost by the way less than one-tenth of the force that has been committed to you for transference; and it is difficult to imagine greater perfection than that. But those who have had to deal with the transference of force through the steam engine stand almost in the exact reversed condition; for they transfer hardly more than ten per cent. of the power and lose 90 per cent.; whereas you transfer 90 per cent. and lose but ten per cent.

When the Great Creator, in the construction of this world, separated the carbonic acid of chaos into its two constituents, and stored away the carbon for the use of man, while the oxygen was liberated in the envelope of the earth, ready to again combine with the carbon, and again produce the force which had been expended in disuniting them, the problem presented to imperfect man was the production of so much force, by again uniting these dissevered elements, as had been expended in separating them. The plain injunction given to him is—be economical of these resources, for they are limited. The coal deposits when once exhausted cannot be renewed; and the existence of civilization on the earth in its present form depends upon the supply of available carbon. The new application of it to the generation of electricity makes a still further demand upon that supply; and as we look into the distant

[*Continued on page* 10.]

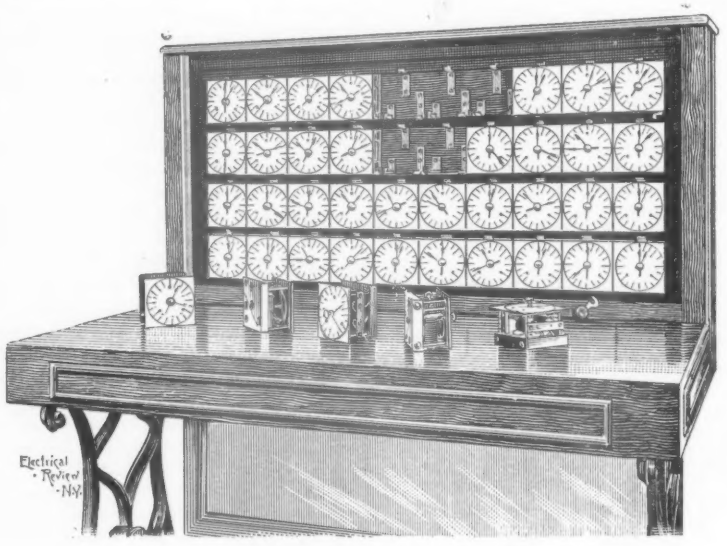

FIG. 3.—THE COUNTERS.

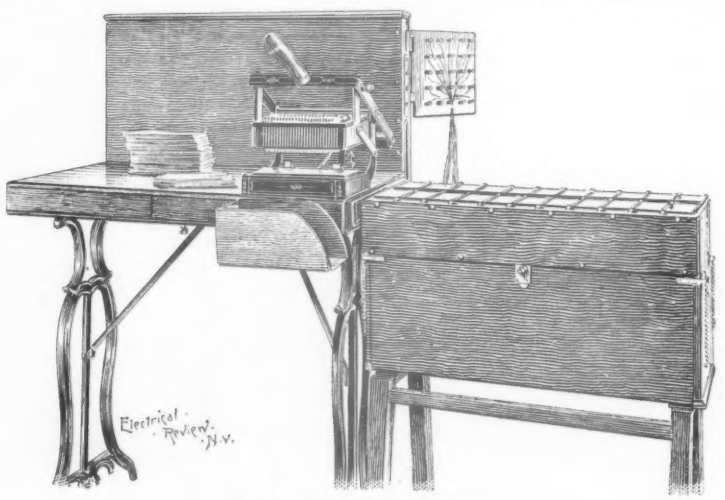

FIG. 4.—THE SORTING BOX.

ELECTRICAL SCIENCE IN CENSUS WORK.

THE VALUABLE INVENTION OF MR. HERMAN HOLLERITH, OF WASHINGTON, AN AID TO RAPID COMPILATION.

The time for taking the eleventh census as required under the Constitution is rapidly approaching, and we think it of special interest to call attention to some facts connected with an enumeration of a population of over 60,000,000, and to point out how Electricity may be employed in facilitating such an undertaking.

Within a few days after the first Monday of June, 1890, there will be deposited in the office of the Superintendent of Census, at Washington, certain records relating to the entire population of the United States. Regarding each person these records will contain the age, sex, race, conjugal condition, relationship to head of family, birthplace, birthplace of father, birthplace of mother, occupation, whether the person can read or write, whether deaf, dumb, blind, insane, idiotic, etc. To form some idea of what such a record means, let us suppose that the data for each person be written in a single line across a strip of paper and that such lines are exactly one-half inch apart; it would then take a strip of paper fully 500 miles long to contain the records relating to population at the next census.

From these records it is necessary to compile the various population statistics. To do this by the ordinary methods, the records must be gone over and over, first tallying or tabulating the facts relating to one class of statistics and then the next, until all the desired information is obtained. With each census the demands for more complicated combination and greater detail in the various tabulations grow more imperative, so that not only have we to consider the increased expense due to increased population, but also the greater per capita cost of compilation due to greater detail required. In the tenth census the expenses of the office of Superintendent at Washington amounted to $2,385,999.50. Though this, of course, included many other expenses, a very large part was used simply for the population tallies, and it must be remembered that not by any means was all the valuable or desirable information contained in the enumerators' returns tabulated. Thus to-day it is impossible to obtain any statistical information regarding the conjugal conditions of our people, though the full data regarding this is contained in the returns of the tenth census. In other words, the enumerators' were charged with collecting much valuable data, thus incurring considerable additional expense, which data was never tabulated probably for no other reason than the expenses involved and the time required to do such work by the ordinary methods.

If we add to the expense of tabulating the population statistics of the tenth census the addditional cost due to the increase of population from 1880 to 1890, and the expense of the additional tabulations which should be made, it becomes apparent at once what a large sum is involved in the proper tabulation of the population returns at the eleventh census.

Not only ought cost to be considered, but we must also consider time and, above all things, accuracy.

Any one familiar with the work of compiling a census, must admit the need of some improvement upon the traditional methods of making tally marks in small squares, and then counting and adding these tally marks. Is not this the merest mechanical work? Cannot the records be written in such a way that a machine could read and tally them? The following method and apparatus has been devised to accomplish this result, and is the work of that very capable and ingenious young scientific worker, Mr. Herman Hollerith, Washington, a well known member of the Electric Club of this city.

This method consists, essentially, in first recording the date relating to each person by punching holes in sheets or strips of electrically non-conducting material (paper), and then counting or tallying these data either separately or in combination by means of mechanical counters operated by electro-

magnets, the circuits through which are controlled by the perforated cards or strips.

As this method has just been adopted in the office of the surgeon-general, U. S. A., for compiling the army health statistics, and as this apparatus is essentially the same as would be used for compiling a census, a brief description of the apparatus there used will be given :

Reports are received each month from each post of the army, giving certain data regarding every person on sick report during the month. These reports, therefore, correspond to the enumerators' returns of a census. Each record is transcribed by punching, to a manilla card, $6\frac{5}{8}$ by 3 inches, printed with the diagram shown in figure 1, the number of the corresponding record having previously been written on the card for the purpose of identification. The region, the division of the region, the particular post, and the month to which the record relates, are recorded on the card by punching one of the spaces in each of the four divisions across the end of the card. As these four punch holes will be the same for all the records of a given report, a special machine is arranged which punches all four holes through four or five cards at one operation, thus reducing the labor involved to a minimum. In case of a census, similar holes would be punched to designate the supervisor's and enumerator's district to which the particular card related. These holes serve positively to locate a card in its proper district. A card misplaced among a thousand, can be readily detected by the fact that one or more of these holes would not correspond with balance of the cards. This is a most important consideration, for if an ordinary card were misplaced among 60,000,000, it would be practically impossible to locate it, while, by the present method, it will detect itself.

The cards are now placed one by one in a machine arranged with a keyboard corresponding with the letters and numbers on the printed card, and the given record is transcribed to the card by punching the corresponding spaces in the various divisions of the card. The card is arranged in general comformity with the records so that, beginning at the right, we punch for the rank, the arm of service, the age, the race, the nationality, length of service, the length of residence at the post, whether the disease was contracted in the line of duty or not, whether admitted to sick report during the month or during a previous month, whether admitted from field, quarters or other source, the disposition of the case, or whether remaining under treatment, whether treated in the field, quarters or hospital, the order of the disease, the number of the particular disease in that order, and finally the number of days treated. In this manner we obtain a complete record which will answer mechanically all questions which can be put to it. If desired, these punched record cards can easily be read and verified, by simply placing them over printed forms, perferably of a different color than the card itself. It is, of course, apparent that a printed card can be punched with an ordinary conductor's punch, or that we can use with a keyboard punch, a blank card, having one corner cut off diagonally to properly locate the card in the subsequent operations.

To tabulate the facts recorded on these punched cards, the mechanism shown in figures 1, 2, 3 and 4, is used. The press shown in figure 2 consists of a hard rubber bed plate provided with suitable stops or guides against which the cards are successively

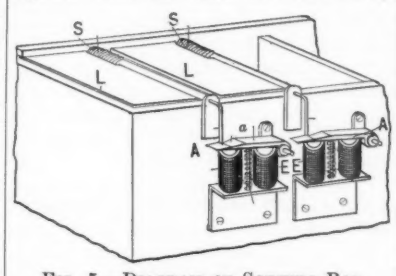

FIG. 5.—DIAGRAM OF SORTING BOX.

placed. The bed plate is formed with a number of holes or cups, corresponding in numbers and arrangement with the spaces on the card, each of which is partly filled with mercury and connected with a binding post on the back of the frame. Above the hard rubber plate is a reciprocating box provided with a number of projecting, spring-actuated, contact points corresponding in position with

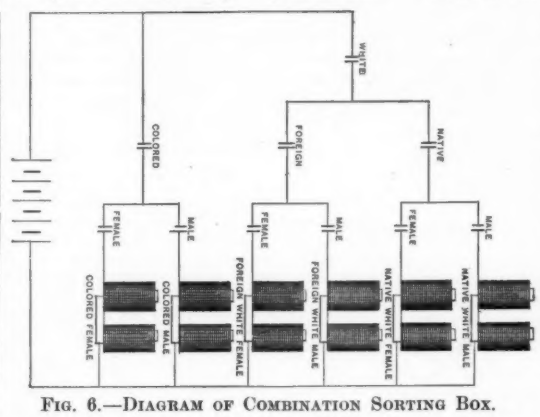

FIG. 6.—DIAGRAM OF COMBINATION SORTING BOX.

the centers of the mercury cups. When a card is placed in the press, and the handle brought down, these pins will form circuits corresponding with the punched record.

Arranged in a suitable frame, as shown in figure 3, are a number of counters, each capable of registering to 10,000. These counters are about 3 inches square, are readily removable and are actuated by electro-magnets terminating in binding posts on the back of the counter frame.

To tabulate any of the facts recorded on the cards, it is only necessary to connect the corresponding binding posts of the press with the binding posts of the counters, and then pass the given cards, successively, through the press, when the results will be shown directly on the counters. The number of facts thus recorded at one operation is only limited by the number of counters which are used.

If, while we are thus tabulating certain facts, it is desirable at the same time to sort or arrange the cards according to any desired data, as, for example, the arms of service, the sorting box shown in figure 4 is employed. This box is suitably divided into twenty compartments, each of which is closed by a lid L, (see diagram, Fig. 5.) held against the tension of the spring, S, by the catch, A, the latter forming the armature of a suitable magnet, E. These magnets, E, are connected with the binding posts of the press according to the data by which the cards are to be assorted. When a card is put in the press, the armature, A, corresponding with the given record is attracted, thus releasing the corresponding lid, L, which remains open until the card is deposited in that division and the lid again closed by hand. This is done with the right hand, while, with the left hand, another card is being placed in position in the press. The sides of the sorting box are hinged to permit the easy removal of the cards when assorted. The sorting of cards can, of course, be done while, at the same time, counting any desired group or groups of facts.

When it is desired to count or sort the cards according to combinations of data, ordinary pony relays are used to control the circuits through the magnets of the counters or sorting box, as shown in the diagram, figure 6. This diagram represents the arrangement of circuits when it is desired to sort or count the cards according to combinations of age, sex and general nativities. The counter or sorting box magnets are connected in circuits controlled by the relays as shown, the latter being connected with the binding posts of the press as indicated. When, for example, a card punched for native, white and male is placed in the press, the corresponding relays are actuated, thus forming a secondary circuit through the magnet native-white-male, thus operating the corresponding counter or sorting box.

In this manner any desirable or possible combinations of the data recorded on the cards may be tabulated. For the more complicated combinations special relays with multiple contact points are constructed. By a little study, however, it will generally be found that a scheme can be arranged which will bring the most complicated tabulation into a comparatively simple mechanical arrangement. If, for example, we have 10 facts, each of which should be tabulated in combination with 10 other facts, we have 100 combinations which would require that number of counters. If, however, we first sort the cards according to the first series of facts, which can be done while tallying other data, and then count the second series of facts on 10 counters, we obtain the same result.

As this work is entirely mechanical, such checks can readily be arranged as to secure absolute accuracy in the results.

In this article reference has only been made to the population statistics of a census and the army health statistics. This method however, is directly applicable to many other forms of statistical compilations, among which may be mentioned the statistics of registration of births, deaths and marriages.

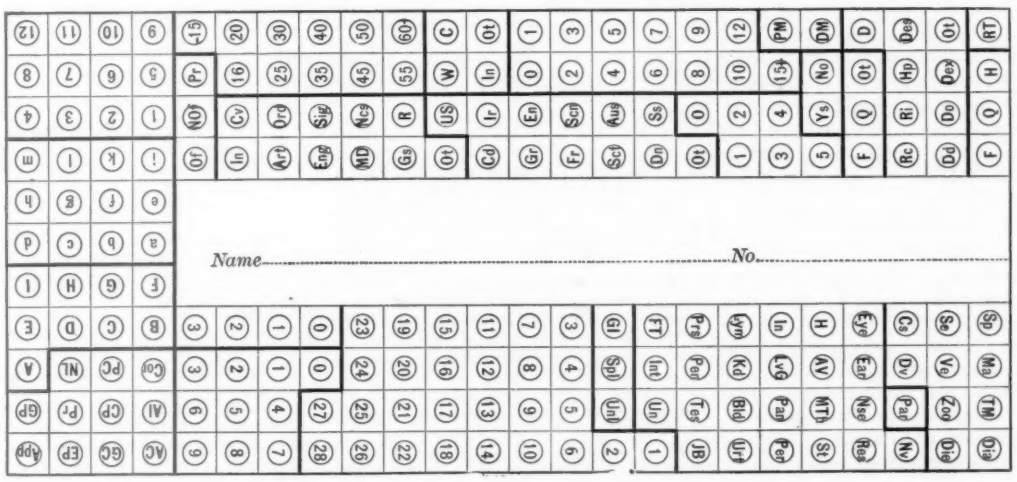

FIG. 7.—DIAGRAM OF RECORDING CARD.

Brooklyn, N. Y.—The Edison Electric Illuminating Company has increased its capital stock from $500,000 to $600,000.

Camden, N. J.—Articles of incorporation were filed by the Fuel Patents Company, of Camden; capital, $120,000, of which $1,000 is said to be paid in.

Birmingham, Ala.—The Merchants Electric Light and Power Company, of Birmingham, Ala., is organized; capital, $20,000; with Judge Winkley and others.

Philadelphia, Pa.—The Eighth Street Electric Light Company. of Philadelphia; capital, $10,000. The James A. Fields' Shoe Company, of Philadelphia; capital, $100.000.

Milwaukee, Wis.—The Champion Automatic Fuel Economizer Company, of Milwaukee; capital, $30,000; incoporators, Edward W. Vinson, Oscar H. Pierce and Charles D. Kendrick.

Quincy, Ill.—The Quincy Plating & Manufacturing Company, at Quincy; capital stock $3,000; for plating (electro) and general manufacturing; incorporators, S. P. Bartlett, A. B. Fanna, and George W. Ascough.

Milwaukee, Wis.—The Wisconsin Storage Battery Company, of Milwaukee; capital, $10,000; incorporators, DeWitt Davis, H. H. Stafford, A. G. Weissert and H. T. West; object, the manufacture of storage electrical batteries.

Milwaukee, Wis.—Articles of association were filed by the Wisconsin Automatic Fire Service Company, of Milwaukee, with a capital of $100,000. The incorporators are George E. West, George Knowles, Jr., and Frank G. Biglow.

Beaver, Co., Pa.—The Brady's Run Fire Clay Company, of Beaver county, capital, $40,000. The stockholders are R. M. Downie and J. R. McKee, and T. L. Kennedy, New Brighton; A. Stewart, West Bridgewater, and E. N. Bigger, Beaver.

Newark, N. J.—The Continental Dynamo Company. The incorporators are: Charles Schumacher, Charles Stern, and Victor Scholler. The capital is $20,000, and the object of the company is the manufacture of machines for the distribution of electricity.

Camden, N. J.—The Blair Manufacturing Company; organized by Camden and Philadelphia capitalists to manufacture machinery and tools, filed articles of incorporation yesterday. The organizers are Joseph F. Blair, of Camden; J. H. Lorimer and William H. Milliken, of Philadelphia. The capital stock is $20,000.

Camden, N. J.—The West Jersey Electric Light, Power and Heating Company, capital stock $25.000. of which $1,000 is said to be paid in. The object of the company, it is said, is to establish a plant and furnish electric lights for Merchantville. The incorporators are G. Harvey Knight Reynold T. Hall, of Merchantville; Martin Van Harlinger and George R. Waite and Theophilus T. Kechlen, of Philadelphia.

Augusta, Me.—Mr. Fogg of Portland presented an act to incorporate the "Commercial Telegraph Company" of Maine. The incorporators are H. S. Osgood, S. R. Small, W. T. Cobb, Charles A. Arnold, S. L. Larrabee, Fred N. Dow, William Engel, Henry Russell, E. J. Slattery, George C. Wing, William D. Pennel and P. O. Vickery. They ask for all the rights pertaining to a telegraph company, with the privilege of stringing wires along the public highways or railroads. The capital stock is named at $100,000, and they ask the right to issue bonds for $50,000.

San Jose, Cal.—San Jose Natural Gas and Oil Company; stock, $100,000. F. Brassey, W. G. Hawley, C. M. Schiele, E. M. Shortridge, C. F. Fleming, C. M. Wooster, C. C. Smith, incorporators.

Washington, D. C.—The Columbia Phonograph Company of the District of Columbia, Maryland and Delaware, has organized with a capital of $120,000, using, leasing and selling phonographs and graphophones. The incorporators are William Walter Phelps, Andrew Devine, William Herbert Smith, Edward D. Easton, Aaron Johns, Chapin Brown, John P. Jeffries, and Mills Dean. Officers were elected as follows: President, Edward D. Easton; treasurer, William Herbert Smith; secretary, A. Johns.

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NEW YORK, JAN. 26, 1889.

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The anonymous scandal-monger is abroad in New York electrical circles. And what a dirty creature he is!

This is the time of year when the untutored legislator attacks all forms of monopoly, so-called, and his loudest and longest and most unintelligent cry is against the innocent looking telephone.

The communication in this issue from that rising young inventor, S. Z. de Ferranti, of London, will be read with interest by all our readers who are keeping informed on electric light work abroad.

Our city authorities should put danger signals over all electrical subway man-holes. Then when the unwary passer-by is hurled against Trinity's spire, he or his heirs won't have so strong a suit for damages.

The parent electric light companies of the United States are apparently realizing the valuable territory for supplying incandescent light confined within the limits of our own Manhattan Island.

That the storage battery is destined to play an important part in the electrical development of the future we think all will admit, and renewed interest in this branch of the industry is very evident. Several new batteries have been recently announced.

An impatient citizen of Chicago is suing for $10,000 damages because he didn't get the electric light. We did think there were enough electric light men in Chicago to relieve his sufferings. When a man wants the electric light that bad, he ought to have it.

The proceedings of the last convention of the National Electric Light Association are now being sent out in pamphlet form to the members of the Association. It is a valuable work, clearly printed, and most conveniently indexed, and has evidently been carefully and intelligently edited by Secretary Garratt.

State Senator Rannell, of Ohio, proposes to have all Buckeye criminals executed by electricity. Of course the senator knows all about electricity, and does not need our advice; still we would respectfully suggest that it might be well to wait and see what the result will be in New York State, where the experiment with this method of executing criminals is on trial.

The bill to regulate the rental of telephones in the State of Ohio has been defeated. The result of such foolish legislation in the neighboring State of Indiana was evidently too fresh in the minds of the Ohioans. One representative very sensibly said that "the legislature had no more right to regulate telephone charges than the fees of the attorneys."

An exchange from Jamestown, N. Y., says the citizens are contemplating the possibility of putting in another electric light plant, provided the existing electric light company will let them know if there is a profit in the business, how the company is managed, etc., etc. For a case of comprehensive and coagulated gall, commend us to this new citizens' movement.

Another electrical subway man-hole blew up in this city last Saturday. Fortunately no one was killed, and damages did not exceed, it was estimated, $1,000. This amount of course does not include the scare that the people of the neighborhood experienced. They thought it was an earthquake or a gas house explosion, similar to the one that so badly frightened half of Brooklyn a few days before.

That pretty little scheme, called the Triple Thermic motor is receiving free advertising in the columns of the N. Y. *Daily Press* and other city journals. There has always been an air *a la* Keeley about this now somewhat ancient motor scheme, and we are glad to be able to say that we never permitted the company's claims to be presented in the advertising columns of the REVIEW; sorry that some of our contemporaries cannot say the same.

From the sound of preparation that we hear, it is evident that the Electric Light Convention in Chicago next month will be the largest and probably the most important in the history of the Association. In addition to the reports of regularly appointed committees, a number of timely papers will be presented and discussed. The question of burying the electric light wires will undoubtedly be a prominent topic, and a valuable report is expected from the committee having the matter in charge. Every one at all interested should be present.

MR. DICKERSON ON THE STEAM ENGINE.

The paper entitled "The Steam Engine, its Principles, its Development, its Present Capacity and its Future Perfection," which was read by Mr. Edward N. Dickerson at the last regular monthly meeting of the Electric Club, January 17, 1889, and which we print in full in this issue, is a remarkably clear and concise summary of historical facts, a recital of the present state of the art and a conservative prophesy as to the future of the chiefest engineering factor which must ever go hand in hand with the development of electro-dynamic machinery until such time as inventors shall convert the energy of disassociated carbon directly into electricity, without transmutation through the energy of physical motion. Thoroughly informed on the historical side of the question, the essayest of the evening led his audience through that portion of his subject down to the hard cold facts of steam engineering difficulties of the present hour, with especial reference to the present knowledge of the theoretical possibilities of the steam engine, and to some of the more disputed points in construction wherein modern engine builders have departed from the earlier types of James Watt, with questionable results.

This paper called forth an interesting discussion on some points of engine construction, notably the comparative merits of single and balanced puppet valves and their economic relation to slide valves.

A FASCINATING TELEPHONE SCHEME.

Every few minutes some brilliant individual comes up from the sea or out of the woods with a scheme to do away with the telegraph, who says he will make stacks of poles into fence posts; turn millions of miles of wire into hoop skirts and rat traps, make relays, sounders and keys into window weights and door step dogs, while telegraph men will be cast adrift.

Such an eruptive fever of discovery has just broken out, and in a comparatively short time a sydicate of Eastern capitalists contemplates entirely net-working the United States and Canada with an electrical seine of—barbed wire fence.

The starting place is Chicago. Commencing at south Chicago, 1,794 miles of this new form of conductor will be erected on the B. and O. Railroad, as fencing steel posts are to be used in place of cedar, and five parallel wires will be strung. The top wire is insulated and "charged" with electricity, and as it passes through an underground conduit at crossings and through cities, a continuous line is formed between Chicago and Baltimore.

All along the line this wire is to be tapped and connected with telephones, designed and constructed for long-distance telephoning, so that telephone communication will be guaranteed and easy of accomplishment between any two points on the line. More than that, the engineer of every train or locomotive will have a handy telephone operated without battery or call bell. In the event of an accident the engineer hangs his telephone on the top wire of the fence, grounds the instrument by running a wire into the earth, and sits down on the grass while he receives orders from the train dispatcher.

Such a line as the above is the spinal cord, so to speak, of a system of electrical nerves ramifying the whole district for miles either side the railway.

The syndicate suggests that all the farms in the country be divided by a well-built electrical fence, and that these be so connected that not only with his neighbor, but with anybody, anywhere from New York to San Francisco, as easily as he can now wink at his neighbor's pretty wife, the honest granger can transact business or simply listen to the gossip down at the "store" on rainy Saturdays, and save the "wear and tear, the mud and swear" of the weekly trip.

A contract has been closed with the multiple contact telephone of the D'Unger pattern, for 250 complete instruments by May 1, and the D'Unger Company agrees to take care of all suits and injunctions, and keep Incendiary Knight from making bonfires of the instruments. The new invention—perhaps one should say discovery—is claimed by its syndicate to have $3,000,000 capital behind it—distance not stated—and will be known as "Jennings' System of Electric Railway Fence." The least sanguine of the promoters of the scheme thinks that not less than 250,000 to 300,000 telephones will be needed for the "Jennings" within four years. Shades of Col. Sellers, how this would have fitted your temperament!

THE HOLLERITH ELECTRIC TABULATING SYSTEM.

We describe at some length in this issue the ingenious invention of Mr. Herman Hollerith, which consists of apparatus that greatly shortens the work of compiling statistics. In census work and all work where a great many statistics are used this tabulating system should be invaluable.

Dr. John S. Billings the well known authority on statistical matters, in an address before the American Public Health Association spoke at some length of Mr. Hollerith's system, and says: "It is comparatively simple, not liable to get out of order, and does its work rapidly and accurately. I have watched with great interest the progress in developing and perfecting this machine, because seven years ago I became satisfied that some such system was possible and desirable, and advised Mr. Hollerith, who was then engaged in census work, to take the matter up and devise such a machine as is needed for counting various combinations of large numbers of data, as in census work or in vital statistics. I think that he has succeeded, and that compilers of demographical data will be glad to know of this system."

The REVIEW is pleased to congratulate its young friend Mr. Hollerith on his success in inventing and perfecting this apparatus, and we have no doubt if the matter is left discretionary with the Secretary of the Interior that this system will be a most valuable aid in the completing of statistics for the next census, as it is now a valuable aid in other statistical fields.

A SURPRISING ANONYMOUS LIBEL.

Two of the daily papers of New York on Friday of last week contained sensational articles relating to a rupture of the heretofore friendly relations existing between Mr. Thos. A. Edison and his attorney, Mr. John C. Tomlinson, and his business and electrical associate, Mr. E. T. Gilliland. The sale of the phonograph rights for this country, in which Mr. Gilliland owned a large interest, was given as the cause of the disagreement, and was made the basis of a series of anonymous interviews attacking the professional conduct of Mr. Tomlinson and insinuating unfair dealing on the part of Mr. Gilliland. No authorized interview was published, Mr. Edison and others refusing to discuss the matter, and the whole appeared as a cowardly and malicious attack on the reputation of the two gentlemen named.

The REVIEW does not believe that it is the province of any journal to parade personal disagreements in its columns, and we exceedingly regret that they appear to exist between the three gentlemen named. Be that as it may, as suit for libel will undoubtedly be brought against the newspapers, the courts, instead of the newspapers, will adjust the whole matter.

The only authoritative statement that has so far appeared is the following:

"Speaking for myself and Mr. Gilliland, I am unable to trace the publications which have recently appeared concerning the sale of the phonograph to the source from which they emanated.

"The persons who made them have concealed their identity. While they have not hesitated to impute the basest motives to us both, they have been careful to refrain from giving their insinuations the support of their names.

"We have therefore resolved to take effective measures to compel our traducers to come out of the obscurity in which they have concealed themselves and to substantiate their statements in person or to retract them. To this end we have resolved to institute proceedings against the newspapers which have been made the chief agents for the dissemination of these slanders, so that their proprietors will be compelled in justification of the publications to reveal the names of the authors.

"We will be entirely satisfied to abide the decision of any jury that may be empanelled to determine the propriety of our conduct. In the meantime, we content ourselves with branding the statements as outrageous, unjustifiable, malignant and cowardly falsehoods."

(Signed) JOHN C. TOMLINSON.

An important patent decision extending the life of foreign patents to the extreme limit of time for which one can be granted, is published in abstract on another page.

NEWS FROM ALL POINTS.

Letters from Boston, Chicago, Washington and the South Filled with Interesting Matter.

OUR BOSTON LETTER.

Utilizing Water Power.—A big scheme is now being worked up in Haverhill, Mass., to utilze 1,000 horse-power in the shape of a water-fall called Mitchell's Falls, above the city, and convey the power electrically into the city to be used for all manner of mechanical work. The Baxter Manufacturing Motor Company are furnishing plans and specifications to carry out this result.

Wire Tables and Formulas.—The Eastern Electric Cable Company has issured a most valuable pamphlet of wire tables and formulas with also a price list of the well known Clark wire. The tables were carefully compounded by Mr H. H. Eustis, the electrician of the company, and with the wiring formulas for lamps and motors make up a most handy and useful little book. Several well deserved press notices on the merits of the Clark wire and the rapid increase in the Eastern Electric Cable Co's. business since its establishment in this city four years ago, are also given.

Electric Railway Work.—At the car works of the Newburyport Car Company there are several cars beautifully painted and ornamented which are to be shipped this week to Bangor, Me., for the new street railway company of that city. These cars will be run by electricity, using the Thomson-Houston system. Mr. Samuel Southwick, electrician for that company, is at work wiring the cars. This work will be done different than any other cars in this section of the country. All wires will be concealed, not one of any kind will be in sight. On the interior of each of the cars will be five incandescent lights for lighting the car. On each end is a patent switch by which the car can be stopped in an instant. Under the seat at the rear end of the car is a lightning arrester, so that no damage can come to the car in a thunder shower. There will be two motors each 15-horse power on every car and they will weigh 7,500 pounds each.

Change of Ownership.—W. A. Bowland, representing the Thomson-Houston Company, has bought 151 shares of the 300 Waltham and Newton railway stock, giving him a controlling interest.

Largest Isolated Plant.—The agents of the Mather system of electric lighting have been looking up the largest isolated electric system in the country, and they have arrived at the conclusion that the largest in the United States, if not in the world, is at the American Waltham watch factory, while the dynamo room is the best fitted up and neatest that can be found on the face of the earth.

Lighting the Inaugural.—Boston is to furnish all the lights for the inaugural ball. The Thomson-Houston Company will manufacture the lamps.

Electric Motor Business.—The following list of installations recently made by several electric power companies, shows the remarkable growth in that direction in this vicinity: By the Baxter Manufacturing & Motor Co., Frank Ridlon, agent, Tremont & Suffolk Mills, Lowell, 6 h. p.; Lamson Store Service Co., Lowell, two 10 h. p.; Walter Coburn, Lowell, 10 h. p.; Jeremiah Clark, Lowell, 10 h. p.; Brookline Town Hall, 6 h. p.; J. H. Long & Co., Boston, 6 h. p., constant potential; Standard Clothing Co., ½ h. p., constant potential; E. S. Clark, Boston, 2 h. p.; Phœnix Electric Light Co., E. Greenwich, R. I., two ½ h. p., and one 1 h. p.; Waterville Electric Light Co., 1 h. p.; Consolidated Electric Light Co., Portland, 2 h. p.; Sargent Bros., Boston, ½ h. p.; Miller & Co., Hayward Place, 2 h. p.

By the "C. & C." Co., Howard & Stone, agents, Edison Phonograph Toy Manufacturing Co., ½ h. p.

By the Eddy Electric Manufacturing Co., Dickerman, Adams & Co., agents, E. A. Green & Co., Boston, 15 h. p.; G. W. Smith, Boston, 5 h. p.

By the Sprague Electric Railway & Motor Co., Sawyer & Blake, agents, Shawmut Bank, Boston, ½ h. p.; A. L. Mariner & Co., 5 h. p.; J. T. Glines & Co., 15 h. p.

Dissolution of Partnership.—The firm of Dickerman, Adams & Co. has dissolved, Mr. Adams retiring. The business will be carried on under the firm name of G. W. Dickerman & Co.

Horses Withdrawn.—On account of the successful working of the electric cars, the West End Co. has decided to take off all the horse cars running between Oak Square Bighton, and the city proper, and the traffic will now be carried on entirely in electric cars.

Schultz Belting.—The New England offices of the Schultz Belting Co., are now at 620 Atlantic avenue. Mr. Mullen, the New England manager, has just returned from a successful business trip to the West.

T. W. S.

Boston, January 21.

OUR CHICAGO LETTER.

Burying Telephone Wires.—The Chicago Telephone Company is now laying twelve 2½-inch iron pipes in concrete, on Washington from Clinton to Des Plains, thence south 200 feet, where these will intersect the company's old conduit system. This will enable it to put all the wires now running to the branch office (some 600 subscribers, besides trunk lines) into the main office in the company's building at Washington and Franklin streets. These conduits will be completed by the first of February and the branch office known as "Four" will be closed by transfer, early in the spring.

Telephone Rentals.—A St. Louis correspondent says that the Bell Company officials there have announced that reduction of rentals by the legislature means no service. The company will withdraw from Missouri. In our own State a bill was introduced into the House at Springfield on the 16th, fixing the rental of telephones at $3.00 or $2.00 each where more are used. On toll lines 15 cents for the first five minutes use of the line, and not more than five cents for each additional five minutes. A final clause for charging or collecting more than these rates, fixes the punishment at $50 to $100 for the first offense, $100 to $200 for the second, and $500 for each subsequent infraction of that nature. The saving clause of the act is bound in the fact that the accused may, if he so elect, be tried by a jury!

Electric Train Lighting—Copper Deposition.—Electric Railways.—Leonard & Izard, of Chicago and Minneapolis, are equipping the passenger trains of the Chicago, Milwaukee and St. Paul road with incandescent plants. The first train left here on the 15th. The cars are wired on an entirely new system, for which patents are now pending. The lights worked perfectly, and the train was beautifully illuminated. These gentlemen recently installed a dynamo for the commercial deposition of copper in the works of the Chicago Copper Refining Company at Blue Island. The dynamo was manufactured by the Edison Machine Works, and has an output of 70 volts and 1,000 amperes. It is working night and day, and giving most perfect results. The same firm has recently completed the installation of the electric railway for the T.-H. Company at Alliance, Ohio, and of the electric railway at Wyatt Park, St. Joseph, for the Sprague Company. The work on the 14 mile road, at Topeka, Kansas, is also being finished by L. & I. for the Thomson-Houston Company.

The Thomson-Houston Company in the West.—The Thomson-Houston Company within the week ending the 15th had taken the following orders: Lime City Gas Co., Huntington, Ind., 30 arc lights; Langley, Low & Alexander, Chicago, an isolated plant of 12 arc lamps capacity; Alliance Street Railway, Alliance, O., 500 incandescent lamps, alternate system; Sleeper, Posten & McGill, Nelsonville, O., a plant of 50 arc and 500 incandescent alternating system; F. D. Wright, Trinidad, Col., 35 arc and 1,200 incandescent, to increase an existing Thomson-Houston plant; Cleveland, O., Rubber Co., 400 incandescent for lighting the company's works; for the Water Department, city of St. Louis, Mo., 20 arc lamps; Reno, Nevada, Electric Co., 600 alternating incandescent, and for Pasadena, Cal., a similar plant of alternate incandescents.

Insulation Formulas.—The Chicago Electric Club at its last two meetings discussed the formulas which have been suggested for the determination of the necessary insulation of electric light circuits. The first formula, that of Mr. H. W. Leonard, the REVIEW has published. In that, the insulation was made equal to the E. M. F. multiplied by a constant, divided by the amperes of current used. At the meeting of the 7th, F. B. Badt, of the Western Electric Company, put upon the blackboard for discussion, five formulas, in which R_1 represents insulation in ohms, E the E. M. F., C the current used, and L the miles of wire in circuit. These formulas are as follows:

Direct incandescent system up to 250 volts, thickness of dielectric $\frac{3}{32}$ of an inch. R_1 equals $E \times 25{,}000$ divided by C. Arc system up to 2,500 volts. $\frac{5}{32}$ dielectric. $R_1 = E \times 1{,}000 \div L$. L being miles—a fraction counted as a mile.

Alternating transformer system up to 2,500 volts dielectric, $\frac{3}{16}$. In mains and primaries in transformers, $R_1 = E \times 2{,}500 \div C \times L_2$. Multiple series same, as mains of the last system, including branches. Incandescent lamps on arc circuits. Same as the second formula, with all lamps in circuit. None of these formulas were satisfactory, and the discussion was continued at a special meeting on the 14th. At the latter meeting the matter was pretty thoroughly canvassed, but there was an absence on the part of those who would be likely to oppose the formula suggestion. New formulas were proposed, discussed, dropped. Finally a motion was made that the second formula, volts × by a constant—say 1,000—divided by the length of wire in miles, be recommended to the municipal authorities and the fraternity generally.

C. C. H.

Chicago, Ill., Jan. 19.

OUR WASHINGTON LETTER.

The Roeblings Secure Electric Boiler Cleaning Rights.—The Electro-Magnetic Boiler Cleaning Company, of this city, has made a contract with the Roeblings' Company, of New York, by which the latter secures the exclusive rights to sell and put up the electric boiler apparatus in New England and the State of New York. The parent company furnishes nothing but the electro-magnets—licensees provide all other necessary apparatus. It is expected that the business will require large numbers of small dynamos to charge the magnets.

Electrical Preparations for the Inauguration.—Royce & Marean have contracted with the Inaugural Committee for wiring that portion of the Pension Building that is to be used for the 4th of March reception, for incandescent lights. The dynamos, lamps, etc., are to be contributed gratuitously by the Thomson-Houston Company. The entire work will be of a temporary character, as the apparatus will be used only on the night of the reception and at a promenade concert to be given the following night and will then be removed. The building will be provided with telegraph and telephone offices for the occasion, and special telegraph offices will be opened at various points along the line of march of the inauguration procession to facilitate the handling the immense crowds which will be present.

The Graphophone Company.—The Volta Graphophone Company, which controls the business for all parts of the world except the United States and Canada, under patents of Professor A. G. Bell, Dr. C. A. Bell, and Sumner Taintor, has elected Professor A. Melville Bell, president, and Charles J. Bell, treasurer. The company has turned the old Howe Sewing Machine works at Bridgeport, Connecticut, into a graphophone factory, under the supervision of Mr. Taintor, and will soon be prepared to issue their instruments, which are of very superior quality.

Imperfect Fire Alarm Service.—A suit has been commenced against the district by some property owners, who claim damages for the destruction of their houses by fire in consequence, as it is alleged, of failure of the fire alarm telegraph to transmit an alarm, when the fact that the particular box had been out of order for several days was well known.

Personal.—Among the important people connected with electrical interests who have been about here this week are W. P. Phillips, Frank L. Pope, and Patent Attorneys Page and Buckingham. Irwin Dugan the old timer of Louisville is attending the meeting of government steamboat inspectors.

Navy Yard Lighting.—The commander of the Washington Navy Yard is asking an appropriation of $15,000 for lighting the yard with arc and incandescent lamps.

The Capitol Lighting.—The report on the Capitol lighting bids was made to the House of Representatives on the 14th inst., as indicated in last week's REVIEW, and referred back to the committee. The report with the full text of the specifications and other papers is printed in the Congressional Record and persons desiring these documents for their files can now get them without making a deposit.

G. C. M.

Washington, January 18, 1889.

A LETTER FROM THE SOUTH.

The Electric Light Different From Gas.—An "Anxious Reader" recently inquired through a Virginia paper if the electric light left burning in your chamber should go out while you slept, if there would be any danger of suffocation!

Edison Municipal System.—Albany, Ga., is jubilant over the completion of their electric plant. Albany will be the smallest city in the world lighted by electricity, and the first in the South to adopt exclusively the Edison incandescent municipal system.

Another Inductive Telegraph Inventor.—Rev. Balus Cade, of Wake Forest, North Carolina, has a device by which a telegram can be sent from a morning train, or from one morning train to another.

Telephone Exchange Managers.—J. P. Hoffer, of Atlanta, Ga., has taken charge of the telephone exchange at Anniston, Ala. Mr. J. Cole, superintendent of this division of the Southern Bell Telephone Company, is settling up the affairs of the company at this point. W. C. N. Ryan, superintendent of the telephone exchange at Anniston, Ala., before Mr. Hoffor took charge, left, on the 1st of January, for parts unknown. It is said that he is short in accounts some $500. Fast living is said to have caused this shortage.

The Stevens Electric Company.—One of the latest industries to interest and supply the wants of Birmingham, Ala., is the Stevens Electric Company, which has just established a public lighting station, and are now running in full operation, a system of the Waterhouse arc and incandescent electric lights. This is the system recently adopted by the city of London, England, which will use 25,000 arc lights. This makes the third electric light company for Birmingham, and the proposed merchant's company will be the fourth.

EDWARD A. OLDHAM.

Charleston, S. C., Jan. 14, 1889.

PERSONAL.

Col. C. M. Ransom and Mr. F. W. Harrington, were Boston visitors to the metropolis last week.

Prof. Bell delivered a lecture Friday, Jan. 18th, to the electrical engineers of Cornell University. His subject was: "Disturbance on Electrical Circuits and Balancing Inductions."

Mr. Chas. Williams, Jr., of Boston, celelebrated the 25th anniversary of his wedding last week. His handsome residence in Somerville was visited by a great many friends, and a delightful evening spent.

Mr. Geo. H. Lewars, the very capable secretary of the Sawyer-Man Electric Company, has had his responsible duties increased by the acceptance of the position of secretary and treasurer of the Consolidated Electric Light Company, and will make his office in future at 32 Nassau street.

Mr. P. H. Alexander has become assistant general manager of the Sawyer-Man Electric Company, in addition to his responsible duties as general agent of the company. In the valuable work of securing business, Mr. Alexander's record is of the best, and it is hard work, intelligently done, that is winning him fresh honors.

Robert Baxter, manager, and Mr. D. Farrell, director of the Halifax, Nova Scotia, Gas Light Company, were among the guests of the Electric Club this week. These gentlemen have purchased of Mr. W. J. Morrison, special eastern agent of the Fort Wayne Jenney Electric Light Company, 1,300 lights plant of the Slattery Induction system.

Gen. C. H. Barney, formerly auditor of the Sawyer-Man Electric Company, has accepted the position of treasurer of the same company, in the place of Mr. G. H. Lewars who resigned as treasurer. Gen Barney is a careful, capable and a well informed member of the electrical field, and the REVIEW is pleased to congratulate him on the recognition of his merits.

Mr. E. M. Barton, president, and Mr. Chas. Scribner, electrician of the Western Electric Company, returned last week from a trip of a month's duration in Europe. The gentlemen left here Dec. 5th, and sailed on their return Jan. 5th. Mr. Barton spent the holidays with his family at Berlin, while Mr. Scribner devoted that portion of his time to visiting the various cities of Europe, and informing himself of the latest electrical work in that country. In conversation with a member of the REVIEW staff, President Barton expressed himself as being well pleased with the success of electric lighting as shown in Berlin where the wires are run underground, and extend up hollow and handsomely decorated poles at various street corners. Our readers will remember that several weeks ago this method of lighting was illustrated in the ELECTRICAL REVIEW. President Barton found the business of his company at London and Antwerp in a very satisfactory condition, and after spending several days in New York and looking into the matter of the magnificent new building his company is building in this city, returned to Chicago.

Highly Honored.

One of our reporters secured copious notes of an interesting event which occurred at The E. S. Greeley & Co.'s establishment recently, and we are sorry lack of space prevents its publication in detail.

The occasion was the presentation of a sword, or more properly speaking a sabre, to Corporal Robert E. Morrison, C.E., the gentlemanly collector of the house, by the employés of the establishment, through the eloquent bookkeeper, Capt. H. L. Bruns, in the presence of the entire staff and some civil and military friends invited to witness the ceremony.

There were present Col. M. W. Goodyear, looking young again; Mr. E. S. Riggs, who supported the honor of representing Gen. Greeley with becoming dignity; Col. O. W. Leonard, distinguished for fine looks; financial magnate J. W. Sands, and others. Capt. Bruns made an eloquent presentation speech, to which Mr. Morrison responded with much tact. The occasion will never be forgotten by the participants; no, never!

Telephonic News

*** The city authorities of Anderson, Ind., have ordered the telephone poles removed, or in ten days will cut them down.

*** The New England Telephone Company will build a new copper line from Brattleboro to Bellows Falls for long distance use.

*** It is when the sleet storms come with their thousands of dollars of damages, that the telephone stockholders wishes they were all working nicely underground.

*** The new route of the telephone company through South Orange, N. J., is not the easiest path imaginable. The citizens want the telephone but they don't want the poles.

*** C. A. Nicholson, general manager of the Central New York Telephone Company, has assumed control of the long distance telephone lines between Troy and Buffalo. Work is being pushed rapidly.

*** The committee having in charge the petitions looking to the regulation of telephone tolls at Kansas city claim that a large number of the subscribers to the Missouri and Kansas telephone company have signed the petitions memorializing the legislature to pass a bill fixing the rate of charges. The work of securing signatures to the petitions was concluded last week, and further proceedings was transferred to the state capital. 1200 names were secured, it is claimed.

*** At the yearly meeting of the Berlin "Electrotechnische Verein," the president, Dr. Werner von Siemens, gave the following statistics on the progress of telephony in Germany. The chief progress in telephony is the employment of bronze wire, which, on account of its lower self induction, and its higher conductivity, is better qualified for the transmission of the weak telephone currents than iron wire. The trunk lines constructed with this wire between Berlin and Hanover, Berlin and Dresden, Berlin and Breslau, work most satisfactorily. Other trunk lines—Berlin—Frankfort—Berlin—Cologne—are being constructed. Besides these trunk lines in the industrial district of Prussian Saxony, the towns of Magdeburg, Bernberg, Ascherseleben, Stassfurt, and Wienburg, have been connected together by telephone.

The following figures will show the rapid strides telephony is making in Germany —

	1887.	1888.	Increase.
Towns with central stations	150	174	24
Subscribers' stations	23,968	31,325	7,357
Telephone lines.....	4,395 km.	5,329 km.	934 km.
Telephone wires.....	39,859 km.	47,865 km.	8,006 km.

Fifty-nine trunk lines are in operation now, against 47 in the year 1887; seven urban installations and three trunk lines are in course of erection; the construction of four more urban installations and two trunk lines has been sanctioned by government. Berlin and its suburbs, inclusive of Potsdam, has 8,981 subscribers, against 6,882 in 1887, the largest number of subscribers of any telephone network. Next to it comes Hamburg and suburbs, with 3,669, against 2,869 in 1887. There are 4,626 telegraph stations provided with telephones, an increase of 492 during the year.

The moment has arrived when, at least at the chief centres of communication, a further increase of air lines will meet with almost insurmountable obstacles, and when the necessity of change from air to underground lines has become a burning question. In Berlin, too, this question has become a practical one, and after long and protracted negotiations with the civic authorities, an understanding has been arrived at with regard to the laying of telephone cables. In all probability this important work, for which the necessary capital has already been found, will be taken in hand during the current year.

The Electrical Subway System of the National Conduit Manufacturing Co.

Now that the question of burying under the surface of mother earth all the electrical wires is up for discussion and decision, the various underground systems of merit are being thoroughly investigated by the telephone, telegraph and electric light people. The number of systems, or rather we should say plans of systems, is very great; it is estimated amounting to nearly one thousand in all. Out of this mass a few systems have come to the front and are now receiving trials from different companies. The National Conduit Manufacturing Co., with offices in the telephone building at 18 Cortlandt street, New York, and works at Hastings on the Hudson near this city, is owner of a wrought iron, cement lined pipe for electrical subways, which we illustrate somewhat in detail this week. The company, although comparatively of recent growth, has already in use nearly a quarter of a million feet of conduits in this city by the Metropolitan Telephone and Telegraph Co, and by the police and fire alarm companies, some 15,000 feet in use in Chicago, and is putting down conduits for the use of the Bell Telephone Company of Buffalo. The Company, of which Mr. C. H. Jackson of Pittsburgh is president, Mr. James P. McQuaide, of this city, is secretary and treasurer, and Edward S. Perot vice-president, is so well satisfied with the life and efficiency of its system that they are willing to guarantee it for 15 years. They make special claims for its desirability as a means of distributing electric light as well as carrying the trunk lines. The joints of this conduit are easily and rapidly made and when completed the pipes present a smooth interior, and it is claimed that they are free from all contraction and expansion. The conduit is adapted to be laid in single duct or in groups of ducts.

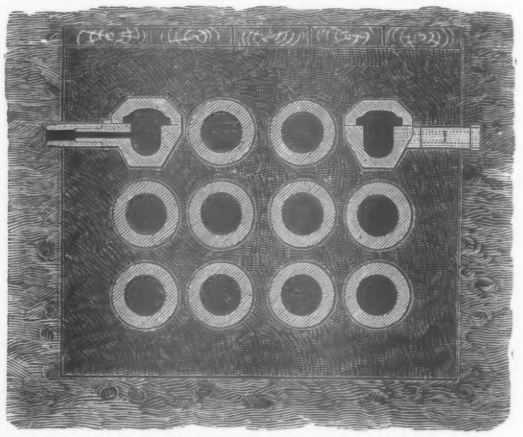

FIG. 1.—SECTION OF MULTIPLE CIRCUIT OF NATIONAL CONDUIT CO.'S SYSTEM.

The REVIEW realizes fully that there are a great many sides to the question of burying electrical wires and has presented a determined opposition to the unwise legislation and outcry on the part of the public ordering all wires underground without regard to present or future services. The question as a whole is far from being solved, yet there are a number of organized manufacturers in the field, like the Conduit Company, whose system we have just described, who are willing to back up their faith with strong guarantees, and these companies are always entitled to respectful hearing and thorough trial.

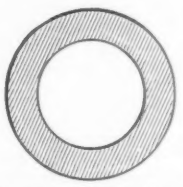

FIG. 3.—SECTION, TRUNK LINE TUBE

FIG. 4.—SECTION, DISTRIBUTING TUBE.

A New Contrivance to Guard Against the Singing of Telephone Wires.

This method, which somewhat resembles the arrangement used for the same purpose by the German Telegraph Office, is due to Messrs. Caël and Beau, Where the wire touches the insulator it is wound with a layer of hemp of the same thickness as the wire, and of 30 cm. length for a wire of 4 mm., of 20 cm. for a wire of 2 mm. diameter. The hemp-winding is protected in the first instance by a caoutchouc tube, slit open lengthways, and of exactly the same length as the hemp-winding and wide enough to completely surround the latter; the diameter of this tube is about 1.5 mm. A lead plate of 0.7 to 1 mm. thickness (according to the diameter of the line-wire) is finally used for covering the caoutchouc tube, the edges of the plate overlapping one another so as to keep out any rain.

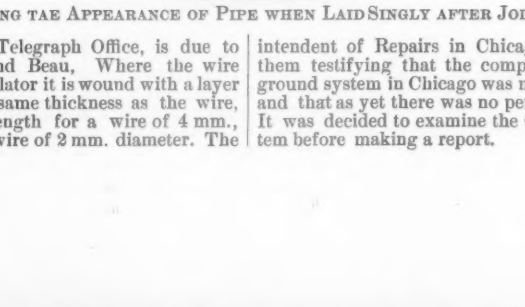

FIG. 8.—SHOWING TAE APPEARANCE OF PIPE WHEN LAID SINGLY AFTER JOINT IS MADE.

Banare's Hydrophone.

At the instigation of the French Government, experiments were made during the month of August at the Brest dockyards in submarine telephony. The leading feature of the system devised by M. Banaré is founded on the fact observed that the membrane of a microphone placed under water can only be thrown into normal vibration when an equal pressure is exercised on it from both sides. To satisfy this condition M. Banaré encloses the microphone in a ball filled with air, which is compressed by the water, and thereby uniformly compresses the air in the microphone case. A balance of the internal and external pressure is thus automatically obtained to whatever depth the apparatus may have been submerged. The ball dips into a column of water, which is lifted above the surface of the sea by the pressure of the air; a balance of pressure inside and outside the microphone case is obtained because the ball is exhausted when there is no water in the apparatus, and is automatically filled with air as soon as the pressure of the water expels the air from the microphone case. Besides this, M. Banaré protects the microphone against external disturbances, as, for instance, the beating of the waves and the noise caused by the latter, and by the movements of the vessel, by placing the instrument in a column of water contained in a metal tube and kept in equilibrium by the pressure of air.

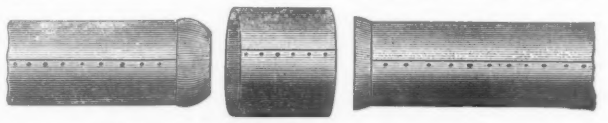

FIG. 7.—SHOWING WROUGHT IRON SLEEVE AND MALE AND FEMALE ENDS BEFORE CONNECTING THE JOINTS WHERE LAID SINGLY.

The whole arrangement is held together by a stranded wire, consisting of three wires of 1 mm. each, which is wound round the lead plate in form of a spiral, and forms a loop in its centre, which is placed round the top of the insulator. To prevent direct contact between the porcelain and the stranded wire, the latter is, as far as it is used for making the loop, protected by a caoutchouc sleeve and additional covering of lead plate.

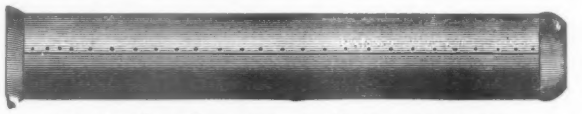

FIG. 2.—PIPE COMPLETE AND READY FOR TRENCH.

The Telephone not a Safe Medium for Communicating Love.

One of the facts brought out in the Trowbridge divorce case, of New Haven, was that Jonathan Ingersoll, the co-respondent, was in the habit of talking over a telephone with Mrs. Trowbridge Mr Trowbridge began to get suspicious, for whenever he telephoned from his office to his house, he found it very difficult to make connection, as the wire was invariably in use. Under the direction of his lawyer, consent was obtained from the proper authorities and the wire was tapped and competent persons employed to write down what passed over the wire. Then the betrayed husband found out what was going on and a suit for divorce followed.

Underground Wires in Milwaukee.

The Council Commission of Milwaukee, recently discussed the ordinance requiring all telegraph and telephone wires to go underground. There were present at the meeting F. H. Tubbs, Western Superintendent of the Western Union; C. H. Sommers, the company's general electrician; and J. S. Robinson, the company's Superintendent of Repairs in Chicago; each of them testifying that the company's underground system in Chicago was not a success, and that as yet there was no perfect system. It was decided to examine the Chicago system before making a report.

FIG. 5.—SHOWING RELATION OF CEMENT AND IRON.

For the purpose of the experiments made at Brest, the apparatus, surrounded by a caoutchouc ball, was placed in a tube closed at the top, whose lower open dart dipped into the sea, the tube having previously been filled with water. Other tubes, in the form of sleeves, surrounded this contrivance. All the numerous noises caused by the water, the wind, the manipulation on the part of the crew, were quite inaudible, and only the signals intended for transmission could be heard. During one part of the experiments the hydrophone was placed on board a stationary vessel, while the vessel giving the signals sailed off to a distance of 5200 m.; even at that distance the transmission of sound was quite distinct. For another part of the experiments the hydrophone was placed on board the sailing ship, whilst a stationary one gave the signals. The former described a circle about the latter, and the signals were quite distinct at a distance of 1400 m. These experiments will shortly be continued on the open sea.

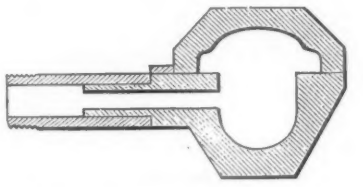

FIG. 6.—STREET BOX FOR HOUSE DISTRIBUTION.

The Telephone in Austria.

BY R. HOWARD KRAUSSE, MANAGER OF THE TELEPHONE COMPANY IN AUSTRIA.

Austria cannot be classed among the commercial countries of the world. It is preeminently an agricultural country. It is therefore not unnatural that the telephone should have been introduced at a later date than in other distinctively commercial countries. Even when, in 1880 and 1881 a private company, the "Wiener Privat Telegraphen Gesellschaft," applied for and obtained a concession from the government to carry on telephone business in Vienna and Brunn, and another company, the "Telephone Company of Austria, Limited," took up concessions granted to private persons (who had neither the knowledge nor the capital necessary to develop this new enterprise), the uses of the telephone were so little understood and appreciated by the public that both companies, until about a couple of years ago, had very uphill work. As an example, showing how ignorant the public were, it may be of interest to mention that the telephone company of Austria had to give up its concession for the town of Cracow, because the town council insisted that the wires should run immediately underneath the projecting roofs of the houses horizontally, and always at the same height above the street (a condition manifestly impossible of fulfilment, the houses varying in height); that they should never cross a street; and that a large sum should be deposited with the municipality, out of which they could pay to any applicant, for damages supposed to be caused by the telephone, the amount *they* considered proper, *without* any judicial proceedings. Many other no less wonderful and curious conditions were made, too numerous and childish to mention. If the companies had not been convinced that ultimately they were bound to succeed, they would long ago have given up their task. Now, after years of losses, both companies are doing very well, every inducement being offered to subscribers, the rates of subscription being among the lowest in Europe, and the service one of the best. Both companies, when starting, decided to utilize the best then known instruments and systems, and have never yet had reason to regret that they did not follow a penny-wise and a pound-foolish policy. The result has justified all anticipations.

In Vienna nearly all the wires are underground. Owing to the very broad streets and numerous open spaces, it was found most difficult to run overhead wires. The company therefore decided on laying cables according to a system of their own devising, which has proved very successful. There being no subways, as in Paris, Vienna is the only capital in Europe in which there are underground cables, the streets being specially opened for them. In the provincial towns worked by the "Telephone Company of Austria, Limited," viz: Prague, Trieste, Lemberg, Graz, Czernowitz, Pilsen, Richenberg, and Bielitz-Biala, all wires are run overhead on single and double standards of a light yet strong pattern of the company's own. The wires are *all* silicium bronze wire, 1.25 mm. diameter, the spans rarely exceeding 50 metres. These lines have hitherto stood the test of the very severe winters of Austria exceedingly well. The wires in Brunn and Linz are also silicium bronze of the same diameter. Nowhere in Austria are there two exchanges in one town, the principle having been always followed (except for a very short time in Vienna at the commencement) of concentrating all lines in one exchange; and to this policy no small measure of the company's success in working is due.

The Vienna Exchange is now supplied with an excellent multiple board, their own patent. This board is arranged for single and for metallic circuit lines, is fitted up for 2,500 subscribers, and gives every satisfaction. In Prague the telephone company of Austria is putting up a similar multiple board. Both these boards are made by Mr. Otto Schäffler, of Vienna, and are of excellent workmanship. In Trieste, the same company is putting up an improved consolidated cord board, which will ultimately accommodate 1,200 subscribers.

The other stations have all the consolidated cord switch boards, put up with some modifications introduced by the company. These last have also been lately adopted by the Austrian Government for their new exchanges. In Brunn and Linz the well-known cross-bar, or Edison, boards are used.

As regards instruments, the Vienna company use in Vienna and Brunn an instrument of their own, a modification of the Blake, a very good and serviceable one, and the Linz exchange a modification of the Edison transmitter. The telephone company of Austria has adopted in Prague the Gower-Bell (following the example of the English G.P.O.), and in all its other stations the well-known consolidated telephone magneto-calls are used without exception.

In 1887, the Austrian government decided to open exchanges in towns for which no concessions had previously been granted, and also to run trunk lines to connect the various towns.

On the whole we may say that in the development of the use of the telephone, Austria is not behind other countries, especially when it is borne in mind there are only about nine towns in the Empire, with a population of 40,000 and upwards; that these towns are widely separated, and that their commerce and industry are limited. The rates of subscription are very low, varying from £5 a year in smaller towns to £7 10*s.* and 8£ 5*s.* in Vienna and the larger towns. The companies pay out of this 10 *fl.* per subscriber, or about 17*s.* 6*d.* royalties to the government, and almost crushing taxes. Only very careful and good installations, very economical management and working, enable them to earn their dividends.

The proportion of working expenses to gross receipts is lower in the telephone company of Austria than in any other company. The figures given in the table will give a fair idea of the gradual development of the telephone in Austria. The new State exchanges have only just been opened, so it is impossible to give statistics of these. This will be done at a latter date.

To the above sum-total must be added about 300 private lines for which the government has granted licenses all over the country, and about 200 subscribers in all the government exchangers, bringing up the total number of telephone lines in Austria to nearly 5,000.

In 1887 the telephone company of Austria introduced in all their stations, with the government's consent, a service for transmitting telegrams from and to their subscribers to the telegraph office. This service has been eagerly made use of by their subscribers, and from 1st January, 1887, to 1st November, 1888, 127,712 telegrams were transmitted, the charge per telegram being one penny.

	Town.	1883. No. of Subs.	1883. Km. Wire.	1883. Km. Cable.	1883. No. of Calls.	1887. No. of Subs.	1887. Km. Wire.	1887. Km. Cable.	1887. No. of Calls.	1888. No. of Subs.
	Vienna	620	1694	1300		894	2659	2969	1,228,134	1600
	Brünn					275	494		416,267	325
	Prag	167	586		53,000	517	1369		874,384	610
	Trieste	131	267		45,000	420	887		865,827	480
	Lemberg	13	9		1,100	228	290		196,276	290
	Graz	123	324		87,000	235	630		175,188	315
	Czernow	12	15		640	98	255		77,178	115
	Pilsen	11	8		630	107	200		94,891	132
	Reichenberg	10	8		620	220	400		254,823	295
	Bielitz B.	13	9		700	130	185		130,076	142
	Linz					171	168		251,391	189
	Total	1100	2820	1300	138,690	3305	7357	2969	4,583,399	4493

In Vienna, the calls were not noted until 1884. For 1888 the *probable* number of subscribers, based on the number on 30th November, 1887, has been given. All the above figures are given for each year ending 31st December.—*The Telephone.*

ELECTRIC RAILWAY ON THE OMAHA & COUNCIL BLUFFS BRIDGE. SEE DESCRIPTION ON 8TH PAGE.

TELEGRAPHIC

.... The Mexican telegraph company has arranged for a second cable across the gulf to Galveston from 220 miles south of Vera Cruz.

.... It is reported from Clinton, Iowa, that an order has been issued on that division of the Chicago and Northwestern Railroad that all the operators of the Telegraphers' Brotherhood must resign from that organization or quit the employ of the Northwestern.

.... The Western Union proposes in about 30 days to rebuild its entire line from Mobile to Montgomery. The wires will be relaid from the door of the local office to the door of the Montgomery office, and a large force of workman will push the reconstruction of the line as fast as possible. The poles to be used are mostly of Alabama cedar, and are of the finest quality.

.... A Philadelphia exchange states that there are rumors that a new telegraph line will be erected between New York and Chicago in opposition to the Western Union, and adds that, though the matter has not yet fully developed, the project is in the hands of men with money, and that a feature will be the renting of private wires at an unprecedentedly low price.

... Mr. George A. Johnson, an electrician, of Mt. Washington avenue, Boston, has in his possession a work on navigation, on the first page of which is a pencil autograph of Gen. Gordon, the hero of Khartoum. Mr. Johnson met the general in China during the time of the Taeping rebellion. The autograph is very faint, and is simply "Gordon, R. E." (Royal Engineers.)

.... On Monday, 6th inst., the Western Union Telegraph Company ran into the office of the Florida Railway and Navigation Company, Point City—what is known as the cable line, which opens this office directly with the ocean cable lines. The cable line passes from Plant City to Bartow, thence to Key West. All day Wednesday, the 9th inst., Mr. Willie, the operator, at Plant City, was receiving cable dispatches from Europe.

....A message received at the Atlanta, Ga. office at 8 o'clock, A. M., was not delivered to its proper address in the city until 1 P. M. It directed a party to leave on the noon train, and was delivered too late to be of value. The sender, Mr. W. H. Godsey, is suing the Western Union Company for $100, under a new Georgia statute, which makes the company liable for a fine of $100 for the non-delivery of a message immediately on its arrival. The case is attracting much interest.

* * The Harrisburg, Pa., Street Passenger Railway Company will soon substitute electricity for horses as a motive power.

* * The East & South Nashville Street Railroad at Nashville, Tenn., contemplate running their cars by electric power.

* * Charles S. Carr, of the Electric Accumulator Company, has gone to San Francisco to take charge of an electric railway there.

* * The Eddy electric company's works are running full time, and are driven with orders. It is rumored that the company will increase their working force considerably in the spring.

* * An electric railway from Old Town to Stillwater, Me., is talked of, and it is proposed to utilize the roadbed of the old Veazie Railroad for the line. The road between the two places is very level.

* * The Pittsfield carriage company has decided to run its factory hereafter by electric motors which are now being put into position. They are to have motors equal to ten horse power and are the second company in town to get their power this way.

* * The Pittsburgh *Dispatch* says: "The work on the electric street car at the Westinghouse electric building is progressing rapidly. It is thus far satisfactory beyond all expectations. Several tests of the motor were made by the electricians yesterday. The minor details of fitting up the car are now being taken in hand, and the car is expected to be ready for its trial trip in about a week."

* * B. W. Porter, superintendent of the electric road, Ansonia, Ct., dropped a 50-pound crowbar on his foot, Thursday afternoon, in the electric freight depot, and sustained a compound fracture of the second toe of the left foot. Dr. Randall was summoned and reduced the fracture. Mr. Porter is confined to his room at the Bassett House, where he will be compelled to remain for several days.

* * Three electric working cars have been built for the West End Electric Railway, Boston, each furnished with snow ploughs, brushes, ice cutters and salt distributors. In front of each car is a large revolving wheel to break up the snow crust, and there are revolving brushes to sweep the track clean. Two 30-horse powers motors propel each car, and special motors work the cutters and brushes. It is estimated that one of these working cars will clear the track quicker and better than an ordinary snow plough drawn by a dozen horses.

Thomson-Houston Electric Railway.

The Omaha and Council Bluffs Railway and Bridge Company started their cars the last of November and since that time they have been in daily operation in a way which has been to the satisfaction of the owners, and to the general public, which is more than pleased with this new means of rapid transit which the road has opened between Omaha and Council Bluffs. The cars on this road are said to be run faster than on any street road in the country, a speed of 15 and often times 20 miles an hour being attained. The power plant consists of two 80 and one 40 horse-power generators.

* * It is rumored in Lowell that a new company is to be organized to run electric cars between Lowell, Lawrence and Haverhill.

* * The Thomson-Houston Electric Co., has closed with the McGavock and Mt. Vernon Street Railway of Nashville, Tenn., for the equipment of a part of its road. The length of the line is 3.07 miles, of which 2.30 is double track and .77 single, making a total length of single track 5.37 miles. There are seven curves on the line and numerous grades, the maximum being 5½ per cent. There will be six cars, each 16 feet in length, and capable of carrying 75 passengers, and equipped with two 10 h. p. Thomson-Houston motors. The overhead system will be used.

Manufacturing Notes.

The Robinson Foster Company has commenced work at Craig's Mills, South Peabody. Superintendent Boynton is in New York selecting machinery for the electric works in South Peabody.

* * The overhead electric system of the Thomson-Houston company, which is to operate the new line of West End electric railway, from Bowdoin square to Harvard square in Cambridge, is now nearly ready, and the date for opening the line is February 15.

The W. Warren Thread Works have found demand for their product in several branches of the electrical field; particularly is this so among manufacturers of covered wire, and the thread company has the satisfaction of knowing that every electrical user of their goods is highly pleased with the quality and strength.

The Cobb Vulcanite Wire Company of Wilmington, Del., have New York headquarters in the handsome new Aldrich Court Building, where samples of their insulated wire will be kept. Mr. J. B. Ecclesine will represent the company in the East. This company will have a fine exhibit at the Chicago Electric Convention, and has also made application for space at the Paris Exposition.

Electrical Talk by the Lowell Board of Trade.

At the annual dinner of the Lowell Board of Trade on Tuesday, the after dinner talk went outside the conventional lines, an address being given by Mr. C. J. H. Woodbury, who spoke on the "Modern Applications of Electricity," giving an account of many practical applications in bleaching paper stock and other textiles, amalgamating gold and the chlorination of silver, as well as use for motive power in mines. Uses of electricity in metallurgy, such as the Thomson electric welding process, electroplating gold on lace, manufacture of copper pipes, aluminum bronze, ferro-aluminum alloys, also for tempering wire and watch springs were also touched upon. An interesting application is for recording and adding statistics by the apparatus invented by Mr. H. Hollerith, which was explained. One of the many stories related was of the experience of the collector of customs in Calais, Me., who asked the department at Washington for instructions in regard to levying duty on electricity fed to lights in that town, wires leading over the bridge from St. Stephens, New Brunswick, where the light plant was situated. The Secretary of the Treasury gave a ruling "that there could be no duty levied on electricity, because it is an invisible or subtle agent of power, possessing no substance as a merchantable commodity."

* * The work of erecting poles for the Daft Electric Railway System, by which the cars of the Newark, N. J., and Bloomfield street cars are to be operated, is progressing rapidly. Posts of Georgia pine 8x8 inches square, and planed, are erected at intervals of 100 feet. Each pole is set six feet in the ground in a bed of cement, to make it durrable. One foot from the surface a piece of two-inch steam pipe is run through the poles at right angles to the back and covered with cement. This acts as a key and prevents the poles from getting out of plume. From each pole an arm of galvanized iron will extend out over the centre of the track. The arms are each seven and a-half feet long. From the arm of one post to that of the next will be stretched the two wires. These will be 22 feet above it. The first trial will be with four cars, each 16 feet long and entirely new. They will be lighted with incandescent electric lamps, and between the windows will be electric push bells to signal the man in charge of the car. At each turnout, suspended from the pole, will be a bunch of electric lights. It is expected that the entire work will be completed, and the cars in operation in 90 days. The work is done under the supervision of Mr. Charles F. Beers, superintendent of the electric light company.

Important Patent Decision Affecting Electrical Interests.

The Supreme Court of the United States last Monday rendered an opinion in the important patent case of the Rate Refrigerating Company, appellant, against George H. Hammond & Co., appeal from the Circuit Court of the United States for the District of Massachusetts.

By statute of the United States it is provided that when a patent is taken out in a foreign country, and one subsequently is taken out in this country, the patent shall expire in the United States with the expiration of the patent in the foreign country in which it first runs out. Under the Canadian law patents are granted for five years, with the privilege of renewal for two periods of five years each. The question in this case was whether the lifetime of the American patent expired five years from its issuance in Canada, or at the end of fifteen years, which is the limit to which the life of a patent may be extended in Canada.

The Supreme Court, through Justice Blatchford holds that the patent in the United States does not expire for fifteen years from the granting of the patent; that is to say, that the lifetime of an American patent first taken out in a foreign country does not expire until the *extreme limit* of time for which an extension of patent may be secured in the foreign country.

The case is regarded by persons interested in patents as one of great importance. Many electrical patents are affected by the decision.

ELECTRIC RAILWAY OF THE THOMSON-HOUSTON SYSTEM ON OMAHA AND COUNCIL BLUFFS BRIDGE.

A New Electrical Company.

The National Electric Manufacturing Company of Eau Claire, Wis., starts off with a new factory, new and improved machinery, and a financial strength reported to be of the best. The officers of the company are H. H. Hayden, president; Fitch Gilbert, vice-president; Ralph Rust, secretary; E. B. Putnam, treasurer; Water K. Freeman, electrician. The business men of Eau Claire who are interested are Mr. John S. Owen, Peter Truax, E. R. Moon, W. A. Rust, H. H. Hayden and the officers named above. The company is organized for the purpose of manufacturing electric light apparatus under the patents of Mr. Freeman.

The commissioners of Hackensack, N. J., propose to light the streets by electricity and are investigating the subject with a view of adopting a suitable system. The president of the Hackensack Improvement Commission, Hackensack, New Jersey, should be seen at an early day.

The Electric Exchange of Boston.

One of the most important meetings in its history was held by the N. E. Electric Exchange, at the Electric Club Rooms on Monday of last week, when a conference was held with the insurance people relative to the raising of rates on property where electric illumination is employed. It was a representative gathering of both interests, and the result of the discussion and interchange of views cannot but prove beneficial to all concerned. President P. H. Alexander was in the chair, and after some interesting remarks, introduced Col. E. H. Hewins of the New England Weston Electric Company, who said:

"We of the electric light fraternity were resting in fancied security, supposing electricity to have become universally recognized as the safest known means of artificial illumination, when our slumbers are rudely awakened by the tariff committee of the Boston board of fire underwriters, who tell us officially that, because of the increasing number of fires set by electric lighting apparatus during the past year (even excluding the Head place fire as exceptional), it will probably be deemed necessary to increase rates on this class of fire risks. It was stated at the meeting where this announcement was made that the number of fires of which there is any record, or upon which the insurance companies suffered loss, had not increased, but that a considerable increase in the number of fires had taken place, the details of which they were unable to learn; and that thus far it has been good fortune only that large losses had not ensued.

"It is certainly within the scope of the work of this exchange to exert its influence to bring about such a condition that it shall be "an object for fire underwriters to recommend the introduction of electricity," and that right here in Boston is the place, and now is the accepted time to test its usefulness. If it goes abroad that the danger of fire is necessarily so great that the fire underwriters have raised the rates of insurance, this exchange has certainly failed of its object."

At the conclusion of the paper there was an animated and interesting discussion on the same, Mr. Frank Ridlon being the first speaker. He said it seemed highly proper that the first statement of the matter should come before the New England Electric Exchange. He thought it might be well to compare the overhead system of wiring and the underground system and try to see where the difficulty really was. That the work being done by the exchange has been, and is, decidedly advantageous. Mr. Osborn W. Howes, secretary of the Boston Building Fire Insurance Company, was next heard.

Col. Hewins wanted to know whether any remedy for violation of inspection rules had been looked for by the insurance people or whether the violations had been permitted to exist with their knowledge. Replying, Mr. W. R. Gray of the Imperial and the City of London fire insurance companies, asked if it was not a part of the plan of the electric exchange to refuse permission to use wiring unless it is put up by men who have been licensed by the exchange. He also raised the question whether the fact that the man who was licensed to complete a piece of work was any guarantee that all the men engaged on the job were licensed men or not. It was not claimed that all the workmen were licensed. The idea was advanced by Col. Hewins that the insurance companies refuse to assume a risk unless satisfied of the proper installment of whatever electric system should be in the building to be insured.

Ex-Mayor O'Brien thought the insurance companies should insist on an inspection of overhead wires by the city "If there was less talk about underground wires," he said, "and more interest taken in a proper overhead system, there would be less trouble with the insurance companies. The danger to-day is with the underground wires, but it is useless to talk about it when every paper in the city is crying 'bury the wires.' If the insurance companies would only press the city to have a proper inspection of overhead wires, I believe the danger of fires would be largely averted. Also, some power ought to compel the removal of the dead wires."

Capt. Brophy, inspector of the New England Insurance Exchange, spoke in behalf of the young men employed by him. He was also glad to see that the tramp wires had been again brought to notice. They were a menace to any city or town. "No city is safe," said he, "no matter what the character of insulation, in which companies allow these dead wires to remain." Mr. Howes stated that all that was desired by the insurance interest was to establish rates commensurate with the risks assumed.

After some further discussion it was voted that the tariff committee of the Boston Fire Underwriters' Union and the electric light committee of the New England Insurance Exchange be invited to meet the directors of the New England exchange at such time as may be agreed upon, for the purpose of securing mutual support and co-operation. This idea aroused much enthusiasm and gratification among the gentlemen present. Mr. Gray asserted that, in his opinion, the first electric company that announced publicly that it would run no current over any wire not put up by one of the men licensed by the exchange would have the "call" over every other electric company, and this opinion was heartily applauded.

It is expected that the day of the conference will be about two or three weeks hence, but it was not decided.

Messrs. Andrew Robeson and J. Y. Bradbury were elected directors to fill vacancies, and steps are being taken for the incorporation of the Exchange.

The Franklin Institute.

The annual report of the Board of Directors of the Franklin Institute, Philadelphia, showed that the membership at the close of the year was 2,081. The new members elected during the year numbered 104; lost by death or resignation, or dropped for non-payment of dues, 178. The financial statement showed that there was a balance January 1st, 1888, of $1,198.49, and receipts from all sources during the year of $28,878.67, making the total receipts $30,077.16. The expenditures were $18,659.67, leaving a balance of $11,417.49, out of which a temporary loan of $2,000 remains to be paid.

The chemical section largely increased its membership during the year, and its work exhibits a most gratifying condition of activity. The electoral section was abandoned during the year. The conduct of the business of the State Weather Service was continued under the general direction of the Committee on Meteorology, and the service is reported to be in a satisfactory condition of efficiency.

The following officers and managers were elected for the ensuing year: President, Joseph M. Wilson; vice president, Frederick Graff; secretary, Wm. H. Wahl; treasurer, Samuel Sartain; auditor, Wm. A. Cheyney. Managers, George V. Cresson, Persifor Frazer, Edwin J. Houston, Enoch Lewis, John Lucas, Samuel P. Sadtler, Wm. H. Thorne, John J. Weaver. Members of the Committee on Science and the Arts, L. L. Cheney, L. D'Auria, J. L. Gill, Jr., F. Leclere, W. B. Levan, Samuel R. Marshall, William McDevitt, J. R. McFetridge, A. E. Outerbridge, Jr.; George H. Perkins, Charles E. Ronaldson, Samuel Sartain, Charles A. Rutter, S. Lloyd Wiegand, Carl Hering.

—— Milwaukee is indulging in a very pretty fight over the question of electric light franchise.

—— Electric lighting for streets, public places and buildings of St. Louis, Mo., is wanted for a term of 10 years, beginning January 1st, 1890. Bidders must state prices of arc lights of 2,000 candle-power each, or incandescent lights of 16 and 30 candle-power each. Address Board of Public Improvements, St. Louis, Mo., until Febuary 28th.

—— A committee of the Abington Commercial Club was appointed, at a meeting Wednesday evening, to consider the plans for a union electric light plant for Abington, Whitman and Rockland, and for an electric street railway connecting those towns. The plans can be carried out they think for $75,000.

—— Judge Goebel has granted the First Cincinnati Edison Illuminating Company the right to erect a plant for lighting by electricity along the streets of that city. The company furnishes a $50,000 bond to comply with the city ordinance, and pays to the city one-half of one per cent. of its gross receipts, the same as the Brush company does, in quarterly installments.

—— In Birmingham, Ala., the advent of the electric light is confidently expected to change the names of several localities. Buzzard, Roost, Pigeon Roost and Scratch Ankle are to be lighted. The electric lights will be up as rapidly as possible, and in a few weeks the localities mentioned will be thoroughly illuminated, and within a few months it is hoped that their names will be mentioned in Birmingham only as things of the past.

Trial of an Electric Car Brake.

The Widdifield and Bowman electric car brake was subjected to a series of tests on January 10, a train of fifteen freight cars being used for the trial, which took place upon the Lehigh Valley Railroad between Metuchen and Easton. A drum about six inches in diameter is cast around the axle of a pair of car wheels. The drum is composed of Babbitt metal, with paper disks embedded in it. A small friction wheel is drawn against this by the action of a magnet excited by the electric current. Only an instant is required to do this, as a ratchet bar and pawl are provided to hold the wheel in place when forced against the friction drum. At once the wheel begins to rotate, and in doing so winds a chain around its axle. This draws a larger wheel with of course greatly increased power against the friction drum. It rotates, and winds the break chain directly around its axle, thus putting on the brake. To release the brakes, another current is sent, which operates a second magnet that unlocks the pawl and ratchet, the friction wheels fall back, and the brakes cease to act upon the periphery of the wheel.

Two storage batteries of ten or twelve cells each are carried, one on the engine and the other in the rear car. With each battery is a switchboard and connections. Thus if the train breaks in the middle, each half is provided with a full brake equipment. An automatic attachment is so arranged that if the train is cut in two by design or accident, the brakes are at once put on. But each switchboard contains a releasing switch, so that if the cut-off occurs in a place where stoppage would be dangerous, the brakes can be released on either or both portions of the train. Attachments are also provided so that brakes can be put on from the roof.

—— The Electric Light Company, of Ellsworth, Me., is to go into the power business. Immense water-power is available.

—— The streets of Wakefield, R. I., are to be electrically lighted by the Narragansett Electric Light and Power Company.

—— The Manhattan Electric Light Company of New York, with offices at 511 Broadway, is a very busy company and is supplying a rapidly increasing list of customers. The Ft. Wayne Jenney system (Slattery induction) is used.

—— The Eickemeyer dynamo is meeting with a large sale in various directions. It is used in many of the electrically lighted trains of the country, and has proven to be most reliable. Bunnell & Co., of New York, handle the dynamo commercially.

—— Electric lights are being put in the State house at Augusta, Me. Two arc lights will illuminate the corridor, and two of each will be placed in the Senate Chamber and the House, while the offices will be plentifully supplied with incandescents.

—— A few nights ago, those who were looking in that direction might have seen a bright and broad ray of light on the top of factory C, Thomson-Houston works at Lynn, caused by testing a 10,000 candle-power light for use on one of the U. S. frigates.

—— The electric light company of Northampton, Mass., has elected A. McCallum, president; C. H. Pierce, treasurer; H. A. Kimball, auditor, and the following board of directors: A. McCallum, C. H. Pierce, E. C. Davis, H. A. Kimball, S. B. Fuller.

—— The dynamo department of the Waterhouse Electric Light Company will shortly be entirely removed to Pittsburgh, Pa., where the machines can be made more cheaply. The department for manufacturing the lamps will be increased in capacity and for the present continued in Hartford, Conn.

—— The Keystone Construction Company has just closed contracts in Toronto, Ontario, with the Consumers Gas Co. for an installation of 3,000 lights, Westinghouse alternating current system, and in Fremont, Neb., with the Fremont Gas and Electric Co. for a 750 light central station, same system.

—— The annual meeting of the stockholders of the Dedham and Hyde Park Gas and Electric Light Company was held in Boston, and the following board of directors was unanimously elected for the ensuing year: J. W. Clark, president; Charles Van Brunt, Gustav Stellwag, W. Eliot Fette and C. A. Taft was elected treasurer and clerk.

ELECTRIC LIGHT NEWS

** Springfield, Mo., is to have an electric street railway.

—— The City of Providence pays 50 cents a night for 247 arc lights.

—— An electric light plant is to be located at Rome, Ga., before long.

—— Worcester, Mass., expects to see her gas and electric light companies consolidated.

—— Fairhaven, Mass., is to have an electric light company, with a capital of $10,000.

—— At the last meeting of the regents of the university of Nebraska, it was voted to light the building by electricity.

—— The electric light company at Manchester, N. H., expects to get 100 more lights in operation by the 10th of February.

—— Rumors of a general consolidation of the electric lighting interests at Rochester, N. Y., are extant. There are three companies.

—— The Portsmouth Gas Light Co. has consolidated with the electric company, and improved service in both lines will be the result.

—— The Citizens Light and Power Company of Burlington, Vt., are anticipating having their plant in full operation in a week or 10 days.

—— Waupaca, Wis., is again lighted by the electric light, a good plant having been built in place of the one swept out by the flood last spring.

—— The Russell & Erwin Manufacturing Company are putting a number of incandescent lights of the Edison patent into their factories at New Britain, Conn.

—— The deal by which the Nashua Elec-Light Company obtained control of the entire gas and electric lighting facilities of that city was consummated last week.

—— The finance committee, of Chicago, recommends payment of balance of $29,000 due the U. S. Electric Lighting Company, but will object to paying interest.

—— T. H. Lyons, one of the experts at the Thomson-Houston Company's works at Lynn, has accepted a position as superintendent of the electric light company of Pueblo.

—— The incandescent electric lights at Rochester, N. Y., are a taking feature for the electric light company, and already more are ordered than the present dynamos can run.

—— The city council of Toledo has ordered wooden boxes built around all the iron electric light poles to a height of seven feet. How the boys will roost on the top of these boxes!

—— The following directors of the Hartford Light and Power Company have been elected: David Henney, A. P. Pitkin, Rober Allyn, A. W. Jillson, W. W. Jacobs, William F. Henney, George Windsor.

—— The West Side Electric Light & Power Co., 502 West 53d street, New York, has been organized with the energetic W. H. Cole as superintendent and electrician. The Slattery induction system will be used.

—— The Electrical Accumulator Lighting and Power Company of St. Louis, Mo., have just closed a contract for the central station electric light plant to illuminate the city of Dyersburg, Tenn., by the storage battery system.

—— There is a movement among the officials of Lockport, N. Y., towards establishing an electric lighting system, to be owned and governed by the city. A committee has been appointed to investigate the question.

MR. DICKERSON'S LECTURE BEFORE THE ELECTRIC CLUB.

[*Continued from Page 2.*]

future we can foresee the time when that supply must fail. Therefore, it is our duty, both to our generation and those who succeed us, to husband those resources against a day of famine. But to do that we must understand the principles upon which the result depends, and learn how to intelligently apply them, and our first duty is absolute obedience to the law of nature in the construction of any machinery whereby we propose to convert a pound of coal into horse-power.

The first fact to be discovered, is the amount of power which is inherent in the re-conversion of carbon and oxygen into the carbonic acid form in which they formerly existed. That is the work of the chemist, and it has been well done many years ago. In round numbers it may be said that a pound of good coal perfectly consumed can produce heat enough to convert about 14 pounds of water into steam, but it varies with the quality of coal. The best boilers will convert about ten pounds of water into steam with a pound of coal burned so that the loss in that step is not very great.

The next fact to discover is the amount of force which results from the conversion of water into steam. That fact is fixed, and can neither be increased or diminished by man's ingenuity or efforts. As a convenient unit to remember, and near enough to the truth for all practical purposes, a cubic inch of water converted into steam by whatever means, or under whatever circumstances, will lift a ton of 2,240 pounds one foot high. A cubic inch of water; a ton of weight; and a foot lift are the simple units. Beginning on that base line, in the direction of the boiler, it becomes important to so organize it as to obtain the greatest evaporation from the fuel burned, and to lose the least amount of heat. In that direction very great perfection has been attained. A practical and good boiler will evaporate about 80 per cent. of as much water as the fuel burned is capable of evaporating, if there were no part of its energy expended otherwise than upon the water; and there is but little left to save. In the other direction, however, the problem is much more difficult. If the engine should be so constructed as to use simply the pressure of steam as it is evolved from the water, then, obviously, the whole effect possible to be produced would be at the rate of a ton a foot high for each cubic foot of water evaporated in the boiler; and that was the condition of the steam engine when James Watt undertook its improvement. In that condition—called "full stroke"—the steam while in the cylinder does no work whatever. It might as well be oil, or any other liquid or fluid. The work it does was done when it emerged from the form of water into steam in the boiler, and pushed out of the boiler the steam above it, which already had done similar work.

Under those conditions, the engine might do less, in consequence of imperfect construction, radiation, and leakage, but it could not possibly do more. James Watt, however, perceived that after the steam had lifted a ton a foot high for each cubic inch of water contained in it, it was in the condition of a compressed spring which, if a part of the weight were removed, would be capable of lifting a remaining part of the weight to a greater height than a foot; and so on as the weight might be diminished. Or, to illustrate: Suppose a cylinder of one square inch area with a cubic inch of water in the bottom of it; and suppose a piston resting upon that water sustaining a platform at the upper end of it on which a ton of bricks is piled up. Now apply heat to the bottom of that cylinder and as the water is converted into steam that ton weight of bricks will be lifted one foot high and there it will stop—all the water having been converted into steam. But the steam spring would be under a pressure of more than 2,000 pounds to the square inch, and obviously capable of exerting an immense deal of force, if any means were devised for giving it the opportunity by expanding. Now, suppose one of the bricks to be knocked off the platform, then the load being diminished, the steam spring would expand somewhat and lift the remaining load a little further; and so by degrees the entire weight might be removed, while the steam spring would be continually expanding until it should come to the freezing point or lower.

How much power can be derived from this operation? That was the question which James Watt answered; and he constructed the indicator, which we now use, for the purpose of giving a graphic representation on a piece of paper with a pencil, of the power in all the stages of its development; and he found that that power corresponded very nearly with the curve of the hyperbola; so that the equation of the hyperbola represents practically the power to be derived from permitting steam to expand after it has been used for all that it is worth as it comes from the water. Without refining, a few figures will be instructive. If the steam be allowed to expand into twice its original volume, it will add 69 per cent. to its normal power of a ton a foot high; or it will lift one ton and $\frac{69}{100}$ths, a foot high for each cubic inch of water. If it be allowed to expand three times, it will lift two tons a foot high. Ten expansions will lift three tons and $\frac{3}{10}$ths a foot high. One hundred expansions will lift five tons and $\frac{6}{10}$ths a foot high; and, obviously, all the weight lifted beyond the original ton a foot high is clear gain, by applying the principle discovered by James Watt.

Then, there is another law of steam which James Watt also discovered with wonderful accuracy, which is, in substance, that no more heat is required to evaporate a pound of water under high pressure than is needed to evaporate it under the atmospheric pressure, or any other low pressure. That is not strictly true, but it requires the most refined and accurate experiments to detect the variations; and those experiments were made by Regnault, the French scientist, under the auspices of the French government 40 years ago, who finally determined the exact truth, which does not practically vary from the formula of James Watt and Dr. Black, his associate.

Those of you who were educated more than 30 years ago, will remember that the text-books stated that "*the sum of the sensible and latent heat of steam was constant,*" which was believed to be true by James Watt. The fact is that a very little more heat is required to evaporate water under high pressure than under low. Regnault's equation shows the addition to be $\frac{5}{10}$ths of the sensible temperature, and it may be disregarded for all practical purposes in calculating the power of the steam engine.

Under this law, therefore, the higher the steam is carried, the longer the range of expansion can be carried without reducing the pressure below the point at which it is practically efficient, and hence the advantage of carrying high steam; but there is no advantage in carrying high steam unless it be accompanied by long ranges of expansion; on the contrary, there is a loss, because it is more likely to leak and is destructive of machinery.

These three laws are the key to the whole problem:

First—A cubic inch of water will lift a ton a foot high converted into steam.

Second—It costs no more fuel to evaporate a cubic inch of water at the pressure of 200 pounds to the square inch than it does to evaporate it in an open vessel; and

Third—The gain of power depends upon the number of times the compressed steam is permitted to expand after it has done the work of lifting a ton a foot high.

Founded upon these principles, the steam engines which were made by Mr. Watt and his associates and pupils before 1830, produced a horse-power with less than two pounds of coal an hour. These engines are known as the Cornish pumping engines; and if you will look into the history of these machines you will find them reported as doing a "*hundred millions of duty;*" which is a technical phrase intended to express the fact that a hundred millions pounds of water were lifted a foot high for a hundred weight of coal consumed. Turning that into horse-power, it means about two pounds of coal an hour a horse-power. This result was produced by cutting off steam in the cylinders at one-eighth or one-tenth of the stroke, and allowing it to expand eight or ten times. The engines of that day, of course, were very imperfectly constructed, and great losses occurred from leaking pistons and from imperfectly constructed boilers; but notwithstanding that loss, the result was equal to two pounds of coal an hour a horse-power.

Executing the drawings of these engines with the tools and machinery of to-day and the result would be appreciably higher. Or, in other words, an engine expanding steam ten times, and evaporating eight pounds of water to a pound of coal in the boiler, and without any losses from leakage, ought to make a horse-power with a pound and a half of coal an hour. These results were obtained by obeying Watt's laws, which I have stated, as nearly as it was possible then to do.

Obviously, two conditions are essential to a perfect obedience of these laws:

First—The valves of the engine must be absolutely tight when closed; and

Second—The closure of the steam valve, when the time for cutting off has arrived, must be instantaneous.

With these two conditions the engine in other respects being practically perfect, the theoretical conditions will be practically attained. But in proportion to the defects in those conditions the losses will increase. James Watt complied with those conditions in respect to his valves by making them absolutely steam tight. They were what is called "single puppet valves"—that is, a tapering plug fitting into a tapering hole with the steam pressure on the upper side. When the plug is ground into the hole then the heavier the pressure upon it the tighter the valve fits. When it is open the steam flows through. When it is shut the steam is absolutely excluded. That single puppet valve was one important element of economy in those pumping engines. The accompany sketch, Fig. 1, illustrates it.

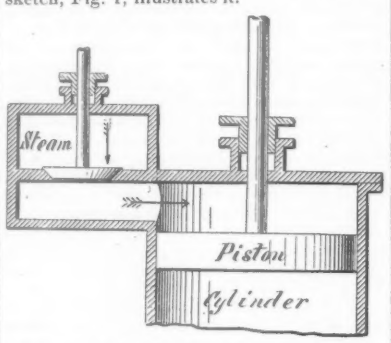

FIG. 1.—JAMES WATT'S SINGLE PUPPET VALVE.

The next element is more difficult to perfect. In James Watt's machines these single puppet valves were closed as rapidly as mechanism would endure, by the mechanical movement of the engine itself. But unless the valve is closed *instantaneously* the steam is "*wire drawn*" through the contracting aperture while the piston is running, and as a consequence a great loss of power results.

More than 40 years ago Mr. Sickels, then an apprentice in the Allaire Works in this city, invented an instantaneous-closing valve, which he did by detaching the valve from the lifting mechanism, driving it shut with high speed, and arresting its fall at the instant of closure by confining a fluid in a cup; and inasmuch as water or air can be pounded forever without injury, no destruction resulted. This improvement perfected the mechanism for carrying out James Watt's laws. It was adopted afterwards by Corliss and most other stationary engine builders and is the only reason for the improved efficiency of that class of engines.

It is the only radical improvement in the steam engine which has ever been made since James Watt left it.

We now hear much of double expansion or compound engines as if they were a novelty, and as if there were some mystery about them. They were perfectly well known to James Watt, and several patents upon them were taken in England, by Wolf and others, in the early part of this century. Their improved efficiency depends simply upon the fact that the steam is allowed to expand through two or three cylinders, whereby a greater range of expansion can be obtained than can conveniently be had in a single cylinder. But no greater effect can be obtained than is due to the expansion of the steam under the law discovered and stated by James Watt. Much less than that is obtained in practice in these engines, because of the losses incident to the transferrence of the steam from one to the other of the cylinders.

In 1825 several steamboats on the North River worked by double expansion engines, were built by Mr. Allaire in this city—the "Henry Eckford" for one, and the "Sun," which made the trip to Albany in about 12 hours, for another. At that time the subject was not well enough understood, and economy in fuel was not considered of so much consequence as the first cost of construction, and these engines were not largely reproduced. One of these double expansion engines made in England was brought to this country in 1830, and for many years was used in the oil factory of Judd's Sons, giving very economical results. When they needed more power, a single expansion engine was made for that factory and added to the other, but its results were vastly inferior to that of the compound engine.

When steamships came to be built in England in 1840 and afterwards, notwithstanding the fact that high expansion with great economy was in constant operation on James Watt's Cornish engines, and on Wolf's compound engines, no attempt was made to work the marine engines under high expansion; and as a consequence all the earlier steamships, for more than 30 years, were running at a cost of at least four pounds of coal an hour a horse power; while at the same time compound engines had been well known for a generation and were in actual use, making a horse power for about two pounds of coal an hour. The Cunard company, however, were making money in their business, and they considered that a sufficient answer to any suggestion that their fuel account was enormously expensive.

This condition of things continued until about 1860, when Mr. Jameson, an English engineer in charge of the steamships of the South Pacific Steamship Company, which was losing money because of the great price of coal at Panama, induced his company to send one of their ships to England, and replace its engine with a double expansion engine. The improvement of course was enormous, and all of those ships were sent round the Horn to England, and fitted with high expansion engines, thereby converting a losing into a profitable business. This experience astonished the English steamship owners, and the White Star Line began to use compound engines, which has been followed up from that day to this, and now they are running about as economically as James Watt's engines were running more than half a century ago; that is to say, at the cost of two pounds of coal an hour a horse-power.

Some of the more recent engines, carrying expansion still further, have reduced their fuel somewhat below that mark, and of course as expansion increases the consumption of fuel will diminish.

In this country the early steamboat engines adopted James Watt's single puppet valves, which are absolutely perfect for a steam engine, but they did not have the cut-off of James Watt, although they used another kind, and therefore did not get the full results of Mr. Watt's plans. Their single poppet valves, however, were of immense value; and Commodore Vanderbilt, who was a very keen observer and a very able man, told me that he had observed that his old steamers on the North River produced power with less fuel than his improved modern steamers, which was undoubtedly true—the reason being that the modern steamers abandoned the single poppet valve of Watt, and substituted for it what is called the balanced valve. That change was made for the purpose of rendering it easer for the engineer to lift the valves by hand with a starting bar, when the engine needed to be worked in starting and stopping; because a single valve has the pressure on the top of it, and as it is made larger the force to lift it becomes proportionately increased. A little steam cylinder would do the work at no cost, but that was not thought of then. The single valve is absolutely tight, but it is impossible to make a balanced valve tight; and the consequence of that change, which was made about 40 years ago, has been to waste by leakage through the engine at least 15 per cent. of all the coal that has ever been burned from that date to this in steamboats; and that continues this day. The astonishing fact exists to-day that on an average every steamboat running on the waters of New York *is wasting certainly not less than 15 per cent.* of all the fuel consumed by leaking through the valves; and almost any one of them will run at the rate of four or five miles an hour without ever opening the steam valves at all, and simply by the leakage through those valves; and that leakage is the difference only between what leaks in through the steam valves and what leaks out through the exhaust valves. Some of these steamboat engines are so constructed that the engineer can unhook the steam valves without unhooking the exhaust valves, so that as the engine moves the exhaust valves are working and the steam valves are shut. That is particularly true of some of the steamboat engines on the New Haven line, and when the pilot rings the slow bell, as he frequently must do in going through crowded thoroughfares, the engineer simply unhooks the steam valves and lets them drop shut, and the steamboat moves on at a fair rate of speed from the leakage alone; whereas if those steam valves were tight the engine would be stopped in half a revolution. This tremendous loss is not appreciated, because it is a case of internal hemorrhage and no visible sign appears. The steam leaks into the condenser and is pumped overboard with the condensing water; but as far as I have observed, it has not raised the temperature of Long Island Sound at all, and therefore has not produced any effect on climate; and so far as I can see there is no advantage gained by that tremendous expenditure. The remedy, of course, is very simple, and that is to go back to James Watt, which would mean at least 15 per cent. of saving in the coal bins. The accompanying sketch, Fig. 2, will illustrate it:

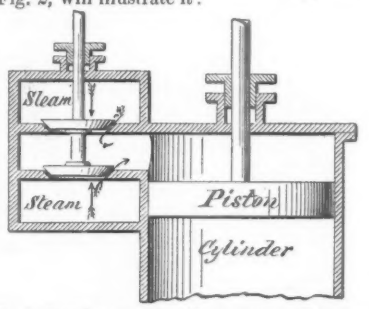

FIG. 2.—AMERICAN BALANCED PUPPET VALVE WHICH MUST LEAK 15 PER CENT. OF STEAM USED BY ENGINE.

In the history of the development of the steam engine one curious phenomenon deserves to be mentioned, and that is the attack upon James Watt and his laws of steam by the Government of the United States during the Rebellion, when vast sums of money were expended in building steam engines. At that time the Government officially pronounced its judgment of condemnation upon the laws of Watt, and published that judgment in a book which was distributed to the engine builders and

engineers of the country as the authoritative decision of the United States. This absurd conclusion was reached in consequence of some experiments ignorantly tried by the government engineers on a leaky engine on Lake Erie, which, as the table showed, was using more than twice the fuel to the horse power than James Watt's engines were using. What was proved by the experiment was that such a machine as that was not a good one to work expansion on ; but it was assumed that it proved there was no use in expansion. I quote from that book the following :

"The results obtained from this engine (that is, the Lake Erie engine) are rigorously applicable to all others in which saturated steam is employed in a cylinder, not jacketed, and *show conclusively the utter futility of attempting to realize an economical gain in fuel, under such conditions, by expanding the steam beyond the very moderate limit of one and a half times*, and that if the expansion be carried to *three times, a positive loss is incurred.* Also that if measure of expansion, as high as those due to cutting off the steam at $\frac{1}{3}$ or $\frac{4}{15}$ of the stroke of the piston are employed, *the economy is considerably less than with steam used absolutely without expansion.*"

Upon that principle the whole steam navy of the United States that was built during the war was constructed. This was a tremendous blow to progress, from which we have not yet entirely recovered ; and but for the fact that the engineers of Europe have built their magnificent steamers, and carried expansion to a high degree, we should have been building a navy to this day in accordance with this ignorance. But James Watt, for a dead man, made a magnificent fight in defense of his principles ; and the money and the resources of the United States have utterly failed to defeat him.

Another singular fact connected with this performance and illustrating how far the authority of a great government is felt in the world, even when employed to disseminate the grossest errors, is that in the recent edition of the Encyclopædia Brittanica, in an article full of apparent learning, these experiments by the United States Government are cited as authority for the most absurd nonsense.

The new steamer "Vesuvius," built by Mr. Cramp in Philadelphia for the government, and exhibiting higher speed than any similar vessel known, expands its steam seven times, and its performance vindicates the law.

In considering the question of economy in engines to be used for the generation of electricity, it is to be remarked that on account of the first cost, and the difficulty of always obtaining condensing water, the so-called high pressure engine has to be largely relied upon for generating power. That is only partially a steam engine. It is driven by steam on one side of the piston, but it is resisted by the atmospheric pressure on the other side, and consequently there is a constant back pressure of 15 pounds to the square inch, which has to be driven out and paid for in fuel without any beneficial result on the work to be done ; and therefore high economy cannot be obtained in a non-condensing engine ; whereas in a steam engine *proper* the back pressure may be reduced to one pound to the square inch and, therefore, it forms a very small proportion of the total work done, leaving a much larger proportion for useful effect. Whenever, therefore, the conditions permit it, a condensing engine should be employed, out of which the maximum economy can be obtained.

The present efficiency of the best non-condensing engines is probably not greater than at the rate of two and a half pounds of coal an hour a horse-power, and of a good condensing engine about two pounds of coal an hour a horse-power, or not materially different from James Watt's engines of 50 years ago. At the rate of two pounds of coal an hour a horse-power, the engine is developing about one-tenth of the power which the coal is giving out in combustion, and nine-tenths are lost ; and the question is, what are the limitations upon the steam engine beyond which practically it cannot be expected to pass in diminishing the consumption of coal in comparison with horse-power ? The enormous loss which I have mentioned is due to the fact that the steam in steam engines can be expended only to a very limited extent. The temperature of combustion may be taken at 2,000 degrees, but the water and steam on the opposite side of the thin boiler plate which separates them from the fire may be only 350 degrees hot, which represents 125 pounds to the square inch, whereas, if material could endure the temperature, and boilers could be made to bear the pressure, steam might be carried at 1,000 pounds to the square inch, and the temperature at 550 degrees, and it would cost a very little more fuel to make the steam at 1,000 pounds pressure than it costs to make it at the atmospheric pressure. At the pressure of a 1,000 pounds to the inch the steam might be expanded 1,000 times, giving eight times as much power as when used without expansion. But practically this cannot be done because material will not endure the heat, the pistons cannot be kept tight, and a little leakage of such valuable steam would destroy the economy. Perhaps the limit to which pressure can be carried practically, with our present knowledge of material and of construction, is 250 pounds to the square inch ; at which steam may be expanded 100 times when it would give $5\frac{6}{10}$ times as much power as without expansion. Under those circumstances, a horse power should be made with about three-quarters of a pound of coal an hour ; and so far as I can at present see, that is about the limit of economy attainable, and that would give us about one-quarter of the power of combustion in dynamic effect.

It is my opinion that with our present knowledge of machinery a steam engine can be built that will produce a horse-power with three-quarters of a pound of coal an hour, if of sufficient size to reduce the percentages of loss by radiation to a minimum. Under those circumstances, your fuel expense would be less than one-third of what it now is.

The future before men of your profession is brilliant indeed. The doors were opened wide by Henry and Faraday, and already you have explored far beyond their imagination. The uses of electricity are now only beginning ; and in a short time it will be the docile companion of man's labors, where now it is dreaded as the treacherous slave. Study the laws of nature, which are the thoughts of God, and do not attempt to rebel against them. We can not create new laws, nor produce force.

> "In pride, in reasoning pride, our error lies,
> All quit their sphere, and rush into the skies.
> Pride still is aiming at the blest abodes,
> Men would be angels, angels would be Gods ;
> Aspiring to be Gods, if angels fell,
> Aspiring to be angels men rebel ;
> And who but wishes to invert the law
> Of order, sins against th' eternal cause."

Do not commit that error ; but, obedient to the laws, work on in adapting them to the uses of man ; and the time is not far distant when with steam power, at the rate of three-quarters of a pound of coal an hour a horse-power—or its equivalent in petroleum—and with 95 per cent. dynamos, you will take possession of the whole field wherever horse-power is to be used for the convenience and elevation of man. [Long applause.]

THE DISCUSSION.

The chairman invited discussion of the address, and Mr. S. S. Wheeler asked for a fuller explanation of the term "duty," or a "million duty"—whether it was an expression of efficiency or effort.

Mr. Dickerson said it was a word invented for use in the Cornish mines, where the problem is to pump water. "It it pumped in pounds and they say an engine which will pump a million pounds of water a foot high with a pound of coal is doing a million duty."

Mr. Wheeler : Then it is a definite amount of work, but as it refers to a definite amount of coal consumed it expressed efficiency ?

Mr. Dickerson : Certainly ; every hundred pounds of coal burnt lifted a hundred million pounds of water out of a mine a foot high. As you asked the question I will give you some more units. A pound of water evaporated into steam will lift 5,875 pounds a foot high, or a pound of coal evaporating a pound of water will do that. If your pound of coal evaporates eight pounds of water it will lift eight times 5,875 pounds a foot high; and as you may say a boiler will do eight pounds of evaporations, therefore a boiler evaporating at the rate to eight pounds of water to a pound of coal, will produce a normal lift of 48,000,000 of coal a foot high for a 100 pounds of coal consumed. Beyond that, whatever is gained is by availing yourself of the principle of expansion, and inasmuch as you can make your steam high you have got the margin of that to realize the benefit of exansion.

Mr. Henry Hine : I would like to know what is to-day considered good economy in in the evaporation of water, a pound of water per horse-power.

Mr. Dickerson : That depends entirely on the kind of engines ;—they are claiming 16, and for locomotives I have seen a claim of 23. But I am not generally stating the duty on the unit of water. Of course you just convert your coal into steam and you get your answer. The best duty—I do not say the best absolute duty—but a two pounds of coal an hour horse-power would mean 16 pounds of water to the horse-power at the rate of eight pounds of water evaporation. But the amount varies in coal with the capacity of the boiler.

The Chairman, Mr. Gilliland : I would like to ask Mr. Dickerson if he thinks the time will ever come when we will be able to avail ourselves of the economy of this form of engine on the locomotive engine.

Mr Dickerson : No high presure engine can ever avail itself of all the economy in the steam because the atmosphere is the constant of resistance at fifteen pounds to the square inch and that limits the range of expansion, for there is no benefit in expanding down below the atmosphere, for there the back pressure is greater than the power and therefore you come to equilibrium and therefore a locomotive can never be made equal to a condensing engine. I have considered that question in reference to atmosphere by using an enormous amount of surface, whether you might possibly get atmospheric condensation, but it is not practicable. Therefore no locomotive can ever be a very economical machine. In my opinion a locomotive will have reached its best efficiency when you get 2 ½ pounds of coal a horse power. The furnace is cramped in between the rails, four feet 8-½, and therefore you have got to burn a great deal of coal to the square foot in order to get the power that the locomotive requires. The coal is thrown overboard out of the stack by the blast and they are burning about 110 pounds of coal an hour on a square foot of grates, when a steamship combustion is only about ten pounds of coal square foot of grates, I do not see how a locomotive can ever hope to do better than 2-½ pounds of coal an hour per horse power.

Mr. Walter C. Kerr : There was one remark made by our very interesting lecturer which I wish to ask a question about, and that was a statement, which was made in a very general way—and I would not take it up in a critical manner, because it was a purely general statement, yet it might need some explanation in the minds of some persons present. It was in relation to the expansions of steam in a single cylinder being for the purpose of producing a given amount of power from that steam just as valuable as the expansion of the steam in two or more cylinders.

Mr. Dickerson : It depends upon a word of explanation, sir ; it is true, or it is not, as you understand the terms of it.

Mr. Kerr : That is when it is strictly a question of expansion, it is true, but we have this enormous condensation of steam which is obviated by the use of two cylinders, which makes the difference in my statement of the two cylinders; and inasmuch as the electric light world is very much interested in compound engines, that is a point which is talked of a good deal, and I thought I would mention it because the statement has been made that there would be no difference.

Mr. Dickerson : I did not mean to make the statement, that there would be no difference in the practical result. But in a single cylinder if the power is to be measured only by the pressure upon the piston, I think it is certain then there would be no practical difference. Now, sir, you have asked a question which would require a good deal of discussion to get through with, and in which I totally differ with the ideas which you have correctly expressed as those which prevail generally. In my judgment it is not true that the initial condensation is of the least consequence in the world—I mean that it has little practical consequence. You have stated correctly what is found in the books, that the initial condensation is a very serious loss, and they state it as high as 20 per cent. in some of the books upon that subject. Perhaps I can explain in a few words what the matter is. Leaky valves are the explanation. Take an indicator card—you have broached that subject—and if you will indulge me for a moment I will illustrate it upon the blackboard. Now I have indicator cards in my possession which prove, or seem to prove, the proposition which you have suggested—cards which I have taken myself from (engines. Illustrating on blackboard.) That is the phenomenon that you refer to, isn't it ?

Mr. Kerr : No, sir ; you are now expressing initial condensation and re-evaporation. I was referring to the initial condensation.

The Lecturer : Very well, the initial condensation is a great evil if it exists, but it is supposed to go along with a re-evaporation. It is in a single cylinder, supposed to go along with a short cut-off re-evaporation—that is the way the card here expresses it. It would be low here and there. Now, says the theorist on that subject, that engine is a splendid illustration of the rapid condensation at the early part of the stroke and the re-evaporation of that condensed water and of the great loss in the stroke in which that steam had become water and lost its efficiency. I will give you an explanation of that. It is the leaky valve that is in most engines. When the steam is in the cylinder at boiler pressure, say, and the gate of that valve shuts then that pressure is as much greater than the pressure in the condenser as the boiler pressure is greater in the condenser. But the pressure of the boiler steam here is no greater, or very little greater than the pressure in the cylinder. If your valves are leaky, very much more steam will leak out than will leak in, because what will leak in will be the difference between the boiler pressure and the cylinder pressure at any given point. When you come down to the middle here (illustrating), the pressure in the boiler is as much above the pressure in the cylinder as the pressure in the cylinder is above the condensers, and then that curve will be a true curve. Then as you go along down the pressure in the cylinder is less above the pressure in the condenser than it is below the pressure in the boiler, then it will leak in much more than it will leak out. Now, in that particular engine, of which I have the cards, if you poured a cup of oil into that cylinder it would run it up from 20 to 22 turns a minute, simply because that oil as long as it lasted was a plug to stop the leakage. (Laughter.) Now, the deductions to which you refer, are made from engines which have leaky valves. I have made a good many engines with perfectly tight valves. James Watt is the old gentleman whose acquaintance I have cultivated. I have made his valve and it is perfectly tight. Errors of engine calculations result to a great extent from the fact that there is a leaky valve, and when I tell you that to-day the steamboat engines all around New York are leaking 15 per cent. of their fuel, you can see what I mean.

Mr. Kerr : The question is whether steam if expanded in two cylinders produced more power than if it expanded in one. I would say that such books as I have had the opportunity of perusing have all stated the contrary of what the lecturer has said, namely, that the amount of power obtained from the expansion of steam is the same whether it is expanded in one or two cylinders. As near as I remember it those are the exact words. I believed that for several years. I taught it for several years. Fortunately I have had an opportunity to unteach some of that to some of the pupils I taught it to. I find going out in practice, supposing you take one Corliss engine with a cylinder of 16 or 32—you put that down and get a water rate of 28 pounds to it. You take another engine of appropriate proportions and size and the water rate comes down to 23.

Now we know when we compound an engine the water rate goes down 25 to 30 per cent. Now I think the gentleman and myself are having a misunderstanding of terms. I think that possibly he understood me to say that it was due to condensation and re-evaporation. If I said that it was not what I meant, and I do not believe that I quite said it. The point I wish to bring up is this. When steam is admitted to a given cylinder there is a certain amount of fallen temperature by reason of the cylinder being reasonably cool. To illustrate on the diagram, if you please (illustrating), we will have an expansion curve like that. The temperature here is 300. The temperature down here I should say is 25. The exhaust takes place and the temperature falls—for the moment, suppose this is not a condensing engine at all. The temperature falls down to 215, slightly above the atmosphere simply. During the back stroke of that engine those cylinder walls are exposed to a temperature of 215. At the beginning of this stroke they suddenly become exposed to a temperature of 300. The first cylinder will be hot and will hold the hot steam ; the second cylinder will be comparatively cool as compared with the first cylinder—and it will take the steam off to the second cylinder—you will therefore never be putting hot steam into a cool cylinder, and we will be getting this advantage in a non-condensing compound engine, each cylinder temperature being appropriate to the mean average temperature of the steam that is entered therein.

Mr. Dickerson : Now that statement that you make is undoubtedly true : It is a true cause. The only difference between what I would say and what you would say would be in the degree to which that true cause produces its effect. My opinion is that the reason why a compound engine is better in low rates of expansion is that it enables steam to be expanded without being murdered by a bad valve gear and when you are expanding it in one cylinder with a bad valve gear you murder the steam, so that you had better have it in two cylinders. No high effect can ever be produced without compound engines : Do not misunderstand me. Any high expansion must use compound engines until the rate of expansion has, but it does not require to use compound engines until the rate of expansion has gone up eight times.

Mr. W. D. Dickey : There are engines in several steamships running out of this port with double puppet valves. The immense power it takes to lift a puppet valve is a large proportion of the power of the engine. We made balance valves to relieve that, but the difficulty was that all single cylinders, although they give good results, we could not keep our crank pins in them and propeller wheels tight. We divided up on two cranks and three cranks with a considerable expansion and divided it, and we had no trouble about keeping our machinery together. One valve leaked and another one did not and if it leaked in the intermediate we kept it in the lower part.

Mr. Dickerson : I shall surprise you by telling you that it takes 40 times as much power to work a double balance valve as it does a single valve.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING JANUARY 9, 1888.

395,963 Incandescent lamp filament; Thomas A. Edison, Menlo Park, N. J.

395,974 Electrical measuring apparatus; Hammond V. Hayes, Cambridge, and Anthony C. White, Boston, Mass.

395,983 Wire cable; Henry Leschen, St. Louis, Mo.

396,009 Forming, brazing and welding of metals by electricity; Elihu Thomson, Lynn, assignor to the Thomson Electric Welding Co., Boston, Mass.

396,010 Method of electric forging; Elihu Thomson, Lynn, assignor to the Thomson Electric Welding Co., Boston, Mass.

396,011 to 396,015 Method for electric welding; apparatus for electric welding and working methods; electric pipe joining and pipe work; electric metal working and method of electric riveting; Elihu Thomson, Lynn, Mass.

396,039 Coupling for electric light fixtures; Reinhold Hermann, Crafton, assignor to Geo. H. Blaxter, Pittsburgh, Pa.

396,086 Synchronizing device for dynamo electric machines; Carl Hoffman, Berlin, Germany, assignor to Siemens & Halske, same place.

396,121 Thermo-magnetic motor; Nikola Tesla, Smiljan, Lika, Austria-Hungary.

396,149 Unipolar dynamo electric machinery; Rufus Eickemeyer, Yonkers, N. Y.

396,156 Electrical attachment for pianos; Francis W. Hale, Boston, Mass.

396,176 Electric coupling for hose pipes; David J. Simpson, Pittsburgh, assignor of one-half to George C. Colken and Hawdon Marshall, Allegheny County, Pa.

396,195 Armature for dynamo electric machines; Leo Daft, Plainfield, N. J.

396,196 Insulator support for electric conductors; Leo Daft, Plainfield, N. J

396,199 Electric appliance for discharging guns; Bradley A. Fiske, U. S. N.

396,207 Electric signaling apparatus; William Henion, Ritchey, Ill.

396,212 Electrical body wear; John V. Long, Jersey City, N. J.

396,213 396,214 Secondary battery; Orazio Lugo, New York, N. Y.

396,269 Electro-dynamic machine; Carl Couper, Cologne, Prussia, assignor to the Helios Actien Gesellschaft fuer Elektrisches Licht und Telegraphenbau, Ehrenfeld, Germany.

396,270 Process of electric welding; Charles L. Coffin, Detroit, Mich.

396,310 Traveler for electric railways; Chas J. Van Depoele, Chicago, Ill.

396,311 396,312 396,313 396,314 Hooked suppender for electric railway conductors; suspension device for electric railway conductors; adjustable crossing and switch for overhead conductors; commutator brush carrier for electric motors; Charles J. Van Depoele, Lynn, Mass.

396,329 Galvanic battery; Paul R. de F. D'Humy, Clapham Rise, County of Surrey, England.

To Contractors for Electric Lighting.

OFFICE OF THE BOARD OF PUBLIC IMPROVEMENTS, ST. LOUIS, January 8, 1889.

Sealed proposals for the public work hereinafter mentioned will be received at the office of the Board of Public Improvements of the city of St. Louis, Mo., until 12 M. of the 28th day of February, 1889, at which hour they will be publicly opened and read, viz:

For lighting with electricity for the term of ten years from January 1, 1890, the streets, public places, and such public buildings as may be designated in the following districts of the city of St. Louis, Mo., viz:

Letting No. 2,503. The district described as the southern district in ordinance numbered 14,697, approved December 29, 1888.

Deposit required, $5,000.

Letting No. 2,504. The district described as the northern district in ordinance numbered 14,697, approved December 29, 1888.

Deposit required, $5,000.

Bidders will state prices per annum at which arc lights of 2,000 candle power each or incandescent lights of 30 candle power each will be furnished, operated and maintained for lighting streets and public places; also prices per annum at which arc lights of 2,000 candle power each or incandescent lights of 16 candle power each will be furnished, operated and maintained for lighting public buildings.

Everything required for the above electric lighting shall be furnished and maintained by the contractor.

The contract with the city will carry the privilege of furnishing electricity for light and power to private parties and corporations along the lines of distribution.

The contract will contain stipulations by which the city of St. Louis may acquire the entire electric plant and appurtenances at the expiration of the contract.

Bidders must submit with proposals general and detailed plans and specifications of the proposed system of distributing the electricity, mode of supporting the lights and wires and of safety appliances.

Proposals must be made on blank forms and inclosed in envelopes furnished by the Board of Public Improvements. The certificate of the Treasurer of the city of St. Louis that the sum of $5,000 has been deposited in the treasury must be inclosed with the proposal.

The right to reject any or all proposals is expressly reserved.

Specifications, form of contract and plans of the districts to be lighted may be seen at the office of the President of the Board of Public Improvements of the city of St. Louis on and after January 28, 1889.

Any contract let hereunder will require the approval of the Municipal Assembly by ordinance.

By order of the Board.

HENRY FLAD, President.

Attest:
EMORY S. FOSTER, Secretary.

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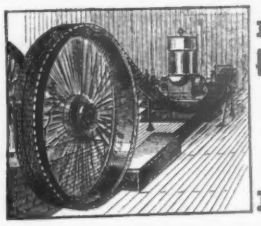

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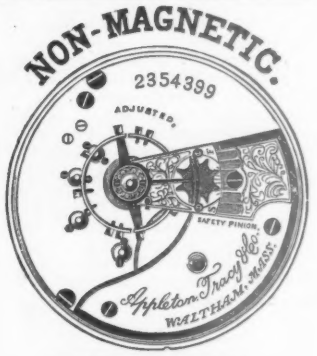

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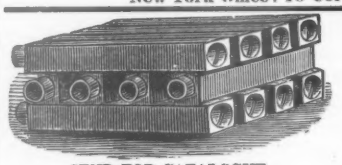

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